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TABLE OF CONTENTS

Introduction

Operating procedures are the least conspicuous facet of monetary policy. Much academic and public attention is constantly devoted to debating the ultimate objectives and strategic aspects of policy. Questions such as "should price stability be the sole ultimate goal?" or "should the central bank adopt a monetary, exchange rate or inflation target?" invariably steal the thunder. In contrast, not much thought is normally given to issues relating to day-to-day or month-to-month implementation of policy and to the corresponding choices regarding operating objectives, tactics and specific instruments.

While to some extent understandable, this relative neglect is unfortunate for a number of reasons. First, it breeds the perception that operating procedures can be taken for granted. Yet ensuring that the central bank has adequate control over monetary conditions is no easy task. Second, it encourages the view that operating procedures are of no consequence. Yet the strategic aspects of policy need to be supported by an appropriate operating framework. Moreover, how policy is implemented can have significant implications for the organisation and functioning of money and even capital markets as well as for asset price volatility. Third, it risks giving rise to potential misconceptions among parts of the academic profession. Typical examples include the common view that the monetary base is *the* key concept in the determination of interest rates; that reserve requirements are necessary, or predominantly used, for monetary control; that the marginal demand for bank reserves can be thought of as a function of the volume of deposits; or that the central bank controls interest rates by mechanically supplying a certain volume of funds to meet a generally well-behaved demand for monetary base or bank reserves. Finally, a proper understanding of operating procedures could throw light on the ultimate power of the central bank to affect monetary conditions, on its source, changing characteristics and reach in the wake of the profound changes taking place in the financial environment.

Against this background, the present volume revisits the subject of operating procedures, a topic last discussed in detail at the Central Bank Economists' Meeting in 1985. For central bankers, it is an opportunity to take stock of how operating procedures have evolved over the last decade or so, of the differences that still divide them and of the forces that may shape future changes. For academics, the contributions contain pointers for deeper and better focused research in the area as a guide to policy-making.

As discussed in the paper by the **BIS**, in recent years monetary policy operating procedures have continued to evolve in response to changes in the structure of financial markets as well as in the broader economic and political environment. To varying degrees central banks in industrial countries have sharpened the focus on interest rates as operating objectives, shortened the maturity of interest rates serving as the fulcrum of policy, strengthened the market orientation of policy implementation, increased the flexibility of liquidity management and improved the transparency of policy signals. While these trends have to some extent extended further a process of convergence dating back at least to the 1970s, significant differences still exist across countries. These differences relate not only to *how* central banks bring about changes in interest rates, but also to the tactics regarding the *size* and *frequency* of such adjustments. A road-map to the volume can be usefully organised around four major themes: the choice of operating objective, policy implementation proper, the size and frequency of policy rate adjustments and likely future developments.

1. The operating objective

As all the contributions in the volume make clear, the fulcrum of monetary policy implementation is the market for *bank reserves* (banks' deposits with the central bank). Central banks need to ensure that the market clears on a day-to-day basis in line with their more strategic policy objectives. By analogy with strategic choices (e.g. that between exchange rate and monetary targeting), at this "tactical" level central banks have to decide how much weight to give to *operating objectives* defined in terms of quantities or prices, viz. bank reserves or short-term interest rates. During the period under review the focus has *increasingly been on interest rates*, implying short-term accommodation of the demand for bank reserves. The paper by the **Bank of Spain** discusses the marked shift in this direction that took place in that country in 1990. However, the process has been more general, if typically less stark elsewhere given differences in initial conditions.

A key reason for this choice has been the conviction that, even where monetary aggregates are still an essential element of policy strategy, a more quantitatively oriented approach in policy implementation would result in greater volatility in short-term rates with little or no gain in terms of medium-term controllability of intermediate objectives. This view emerges clearly in the paper by the **Deutsche Bundesbank**, had motivated in part the abandonment of non-borrowed reserves targeting by the **Federal Reserve Board** and is suggested in the paper by the **Netherlands Bank**, where it is pointed out that similar operating frameworks can support different strategies. But the trend probably has its origins in broader changes in the economic environment. The papers by several **European central banks** note how the elimination of residual exchange controls and, in some cases, the greater emphasis placed on the exchange rate have called for finer control of interest rates. The only central bank that in principle still defines its operating objective in terms of bank reserves (giro deposits) is the **Swiss National Bank**. The corresponding paper, however, notes that this strategy has been pursued in an increasingly flexible manner in order to avoid the risk of temporarily misdirecting policy owing to instability in the demand for giro deposits.

In addition to strengthening the focus on interest rates as objectives, central banks have tended to *shorten* the maturity of the interest rates serving as operating objectives (e.g. papers by the **Bank of Canada**, the **Bank of Belgium** and the **Bank of Italy**). As a result, the *overnight rate* has become by far the most common operating objective. Central banks either set explicit targets for it or, under normal conditions, do not allow it to deviate much from the key policy rates under their direct control, generally *tender* rates at somewhat longer maturities. At the same time, they may accept large fluctuations in the overnight rate, together with, or in relation to, tender and other official rates, as required by specific market conditions, most notably when exchange rate commitments are tested by the markets. Few countries retain a focus on rates at longer maturities; the **Bank of England** explains why it does so. But, quite apart from the specific institutional features of the transmission mechanism that rationalise the choice, there are reasons to believe that the choice of operating objective itself has a significant influence on the role of the corresponding rate in the transmission mechanism, as noted in the **BIS** paper. The reason is that market participants pay particular attention to what the central bank is thought to focus on in order to infer its policy intentions. The paper by the **Bank of France** sheds further light on this issue.

The shortening of the maturity focus in policy implementation is fully consistent with the strengthened market orientation of policy in all countries. Moreover, it is in line with the wish of some central banks to extract from prevailing rates as much information as possible about market participants' expectations of future movements in interest rates. In this context, the development of options markets allows central banks to obtain richer information about the uncertainty with which those expectations are held, a point discussed in some detail by the **Bank of England**. As argued in the **BIS** paper, however, the shortening could also be taken as a sign of the inevitably growing power of market forces in determining asset prices and hence of the increasing constraints under which central banks operate.

2. Implementation: liquidity management and signalling

It is common to think of central banks as steering the operating objective by mechanically supplying a certain amount of reserves to meet the banks' demand. However, as noted in the **BIS** paper, it is more useful to see monetary policy from two complementary and related perspectives: as a set of instruments and practices for equilibrating the supply and demand in the market for bank reserves ("*liquidity management*") and as a set of mechanisms for communicating the central bank's policy intentions so as to guide market expectations and hence the market rates ("*signalling*"). The main instruments for liquidity management include reserve requirements, standing facilities and discretionary, largely market, operations. Policy signals may be sent through some of these instruments or separate announcements.

The picture emerging from the various contributions is that while certain differences still exist across countries, a number of *common trends* can be discerned. Their effect in several cases has been to tend to *strengthen* the distinction between the liquidity management and signalling aspects of policy, as central banks have attempted to reconcile a greater market orientation with close control over interest rates.

A first salient international trend has been the continuing *major reduction of bank deposits held at the central bank in connection with reserve requirements.* A number of papers look into this development from a national perspective, notably those by the **Federal Reserve Board**, the **Deutsche Bundesbank** and the **Bank of France**. The trend has largely reflected deliberate policy actions, encouraged by domestic and international competitive pressures and designed to limit the implicit tax associated with the requirements. In addition, in some cases it has been accelerated by compositional effects, such as increases in eligible cash holdings and banks' attempts to circumvent existing requirements. This is most vividly illustrated by the rapid growth of retail "sweep" accounts in the United States, the focus of the paper by the **Federal Reserve Board**. The main implication of these developments has been a reduction in the scope for reserve requirements with *averaging provisions* to automatically stabilise fluctuations in the overnight rate. The reduced scope to perform this "*buffer function*", by far the most important and widespread function of reserve requirements, results from the smaller room available to individual banks for tolerating deviations in reserves from the average requirement. These developments have placed a greater burden on other mechanisms for limiting interest rate volatility and/or its potential impact on the pass-through of policy.

At the same time, attitudes towards the usefulness of reserve requirements with averaging provisions still vary considerably across countries. Some central banks, most notably the **Deutsche Bundesbank**, greatly value their stabilising function as it avoids the need for frequent presence in the market, be it via standing facilities or market operations. Similarly, given legal constraints ruling out the payment of interest on reserves, the practice of operating "early" in the day and the banks' continuing reluctance to turn to the discount window, the **Federal Reserve Board** is concerned that the fall in operating balances associated with "sweep" accounts could lead to excessive volatility in the federal funds rate, its operating target; such an increase in volatility had already taken place in late 1990-early 1991 in the wake of a sharp cut in the requirements. In contrast, other central banks stress the implicit tax element of the arrangements as being inconsistent with a market orientation of policy. Moreover, they see little problem in frequent central bank intervention, whether through market operations (e.g. the **Bank of England**) or, more controversially perhaps, through overdraft facilities aimed at smoothing interest rate fluctuations (e.g. the **Bank of Canada** and, though not discussed in the paper, the **Netherlands Bank**). Payment of interest at some market-related rate could represent a compromise between these two views.

As most papers indicate, the second major international trend has been the *greater liquidity management activism*, mainly in the wake of the decline in reserve requirements and the pressures of increasingly mobile international capital in a period of heightened focus on exchange rate objectives in several countries. Such activism has largely been implemented through *discretionary market operations at the expense of standing facilities*: market operations are widely seen as more consistent with the preference for a market orientation since they reduce the need for bilateral transactions with the central bank that could inhibit the development of an interbank market. With few exceptions, standing facilities nowadays serve primarily as safety valves for end-of-day or end-of-maintenance-period residual liquidity imbalances and as a means of underlining the medium-term policy stance. The paper by the **Austrian National Bank** discusses how its heavy reliance on standing facilities, which has set its operating framework apart from those applied in other countries, has been tempered since 1995 by the introduction of regular tenders, a first step towards a greater alignment with frameworks elsewhere.

As regards market operations, central banks have generally broadened the range of instruments, shortened the maturity of the transactions, increased their frequency and complemented regular basic refinancing operations with others taking place as required by changing circumstances ("rough" and "fine-tuning" operations). In Europe, many of the changes were adopted in the wake of the ERM turbulence in 1992, which put existing arrangements for liquidity management under severe strain (see, in particular, the contributions by the **BIS**, the **National Bank of Belgium**, the **Bank of Spain** and the **Bank of France**).

Within the range of instruments, *reversed transactions*, especially against domestic-currency-denominated assets (e.g. repos) *have become by far the main policy tool* – the third major trend. Several papers stress that these instruments can greatly increase the flexibility and effectiveness of liquidity management, not least by decoupling the maturity of the injection/withdrawal of liquidity from that of the asset temporarily transferred in the transaction. The very rapid development in recent years of private repo markets (i.e. those not involving central bank participation through special transaction procedures) has further strengthened their dominance as a monetary policy tool. In contrast, outright transactions in secondary markets for securities generally play a much smaller role. As the respective contributions indicate, the **Bank of Japan** and the **Bank of England** are still two major exceptions in this regard. Nevertheless, prospective changes in their operating procedures are set to increase the role of repos, in line with their prominence elsewhere.

The fourth trend emerging from the papers is *increased transparency in policy signals as to desired interest rate levels*. This has essentially taken two forms. One is explicit announcements of targets for operating objectives, be these point targets (e.g. **Reserve Bank of Australia** and **Federal Reserve**), specific ranges (e.g. **Bank of Canada**) or broad indications of appropriate levels (**Bank of Japan**). The second is a revealed preference for tender techniques where the central bank's decision regarding interest rates is made more transparent (e.g. fixed rate as opposed to variable rate tenders or, alternatively, a rather special use of what are in principle variable rate tenders); most continental European countries fall into this category. As discussed in several papers, especially those by the **Bank of England**, the **Bank of Canada** and the **Reserve Bank of Australia**, this shift towards greater transparency is part and parcel of the similar broader shift affecting the other levels of policy, ranging from ultimate goals and specific strategies to the decision-making process itself.

The **BIS** paper emphasises that the need for policy signals is partly due to technical factors pertaining to the special characteristics of the demand for bank reserves. Typically, given the most common arrangements governing interbank settlement systems and the conditions for central bank end-of-day assistance, the demand for working balances is highly interest-inelastic. Alternatively, expectations about future short-term rates are key where reserve requirements with averaging provisions are the main determinant of (marginal) demand. Unless the central bank decides to rely heavily on standing facilities or equivalent arrangements, signalling is necessary for close control of the overnight rate. The point is that under the foregoing conditions, equilibrium in the market for bank reserves has strong "self-fulfilling" elements to it. The credibility of the signal is in turn ultimately backed up by the ability of the central bank to provide as much reserves as needed by the market at a given overnight rate because of its position as monopolist supplier.

At the same time, the various contributions make clear that the most important factor behind the increased transparency in policy signals has probably been the heightened role of market forces in determining interest rates and, arguably, the greater importance of interest rates in the transmission mechanism, both directly and indirectly, via induced changes in the exchange rate. In such an environment, providing a firm anchor and strong guide for market expectations becomes vital for influencing interest rates at the various maturities and containing undesired volatility. The papers by the **Deutsche Bundesbank**, the **Reserve Bank of Australia** and the **Bank of Japan**, to name just a few, go into these issues in some detail. In addition, the link with the increased transparency and accountability called for by the adoption of inflation targets is widely acknowledged.

But just how far should transparency be pushed? Clearly differences of opinion persist in this regard. Some central banks, notably those in **English-speaking countries**, see few, if any, drawbacks in transparency. Other central banks are more concerned about the potential loss of flexibility in adjusting interest rates which greater transparency may entail. This sceptical view is forcefully argued in the paper by the **Swiss National Bank**. It also explains the use of "noisy" tender techniques such as variable rate tenders and low-key quantity signals (via the path of reserve accumulation) for effecting small policy changes described by the **Bank of Italy**. And it lies behind the practice of switching from fixed to variable rate tenders as a way of modulating the strength of the signal depending on changing circumstances, as outlined in the contribution by the **Deutsche Bundesbank** and as is done by the **Bank of Sweden**. Similarly, a range of views exists regarding the appropriate degree of openness about the likelihood of *future* changes in policy rates or the specific rules, if any, that govern them ("reaction functions"), especially at the tactical level.

Attitudes towards transparency, and the relative weight attached to exchange rate objectives, partly explain differences with respect to the *variety of policy signals* employed. The wish to send an unequivocal and easily understandable signal favours the use of a single mechanism, typically an explicit target announcement, as discussed in the papers by the **Bank of England** and the **Reserve Bank of Australia**. In contrast, the desire to modulate the intensity and visibility of the signals or to differentiate the medium-term policy stance from the need to resist unwelcome exchange rate pressures tends to favour the adoption of a broader set of mechanisms, as described in some of the papers by **continental European central banks**. Among these, those relying on adjustment in the liquidity position of the banking system have become less significant. One such example is the calibration of the path of reserve accumulation during the maintenance period, with an acceleration (deceleration) indicating a willingness to ease (tighten) the policy stance. (See the **Deutsche Bundesbank** paper.) A second is the practice of inducing small end-of-day surpluses or shortages of liquidity, possibly absorbed by standing facilities (see the contributions by the **Deutsche Bundesbank**, the **National Bank of Belgium** and the **Bank of Canada**). This has further tended to underline the distinction between the liquidity management and signalling aspects of policy.

3. Size and frequency of policy rate adjustments

At a tactical level, monetary policy can be characterised not only in terms of operating objectives and procedures for steering market interest rates, but also in terms of the patterns of adjustment in policy rates themselves. From this perspective, one major common feature and one salient cross-country difference stand out.

The common feature is that, regardless of the size of the steps, central banks generally *move interest rates several times in the same direction before reversing policy* (see the Table). Moreover, the apparent dislike for reversals is underlined by the fact that the interval between policy adjustments is often considerably longer before changes in direction. Since the size of the steps at reversals is not systematically larger than at other times, this pattern of adjustment has been interpreted in some academic circles as suggestive of a tendency to move "too little, too late".

The possible explanations and implications of this pattern of adjustment are discussed in a number of papers in this volume, including those by the **Bank of England**, the **Bank of Sweden**, the **Bank of Italy** and, in greatest detail, by the **Reserve Bank of Australia**. The possible rationalisations include uncertainty about the evolution of the economy and the speed and strength of

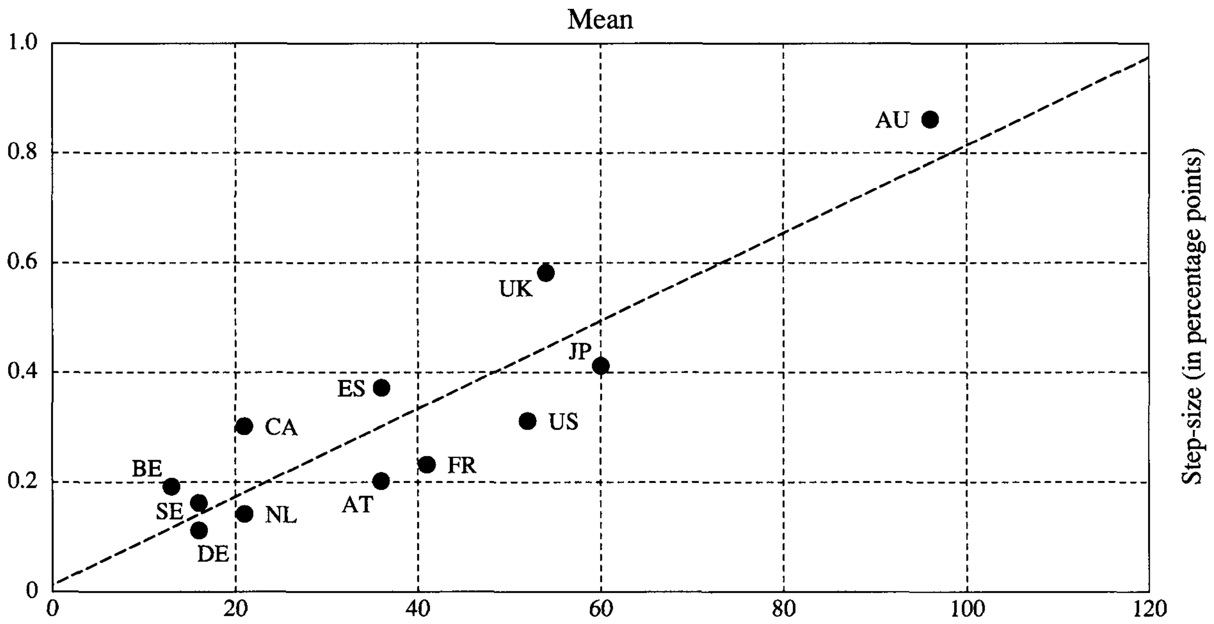
The policy rate: sample period and pattern of adjustments

Country	Sample period		Number of changes	Sequence of adjustments			
	begins	ends		Tightenings		Easings	
				++	-+	+-	--
AU	23/1/90	6/9/96	18	2	1	1	13
AT	1/6/89	30/9/96	47	7	0	1	38
BE	29/1/91	30/9/96	106	9	7	7	82
CA	15/4/94	23/9/96	26	6	1	1	17
FR	12/10/88	30/9/96	50	6	1	2	40
DE	12/8/85	30/9/96	175	55	20	20	79
IT	1/1/91	30/9/96	22	4	3	3	11
JP	25/2/91	30/9/96	19	0	0	0	18
NL	1/1/90	30/9/96	82	9	5	6	61
ES	1/7/90	2/9/96	39	3	4	5	26
SE	1/6/94	30/9/96	36	14	1	1	19
UK	10/3/87	30/9/96	44	12	4	4	23
US	10/8/89	30/9/96	31	6	1	1	22

Key to symbols: ++ = an increase that follows an increase; -+ = an increase that follows a decrease; +- = a decrease that follows an increase; -- = a decrease that follows a decrease.

Note: For Australia, Canada and the United States, overnight interest rate; for Austria, GOMEX; for Italy, discount rate; for Japan, estimated overnight rate objective (approximate only); for other countries, tender rate.

Adjustments in policy rates: step-size and duration



Note: See the table for the choice of policy rates and sample periods; Italy is not included. The picture is very similar in terms of median size, or if the sample starts in 1990.

the transmission of policy impulses, a desire to provide clear guidance to markets so as to strengthen the pass-through along the yield curve, possible fears of destabilising markets, and concerns about the potential loss of credibility if the reversals are attributed to a lack of consistency and poor judgement.

Some of the papers note that, as long as policy is sufficiently forward-looking, the risk of moving "too little, too late" need not materialise. This is an area that will probably attract considerable further attention in the future.

In contrast to the common tendency to move policy rates in an autocorrelated fashion, central banks exhibit *substantially different revealed preferences regarding the size and frequency of adjustments* (see the Graph). Some central banks, notably the **Deutsche Bundesbank**, tend to move in small and frequent steps; others, most vividly the **Reserve Bank of Australia**, do so in large and infrequent ones.

Some of the contributions in this volume cast some light on this issue, which is addressed more specifically in the papers by the **Bank of England** and the **Reserve Bank of Australia**. In part, existing differences are no doubt related to different historical inflation levels and the types of unforeseen events to which central banks were responding during the period under consideration, notably market pressures on exchange rate commitments. In addition, they may to some extent reflect different attitudes towards the merits of transparency, with small steps sometimes being associated with the adoption of variable rate tenders. Nevertheless, other reasons also play a role. The **Deutsche Bundesbank** appears to prefer small steps as a means of limiting market volatility; the **Bank of Sweden** finds some evidence that *changes* in the size of the steps tend to increase the volatility in market rates, which might suggest that markets grow accustomed to specific patterns of adjustment. In contrast, the **Reserve Bank of Australia** argues that large steps help to strengthen the pass-through of policy and plays down the risk that large steps at long intervals could delay policy adjustments. More generally, however, the implications of these differences remain largely unexplored.

4. The future

The various contributions to the volume contain some indications about likely future developments in operating frameworks and the forces underlying them. These relate to the degree of convergence and to the direction of change.

The process of convergence is bound to continue further. In much of Europe, this has recently been accelerated by preparatory work for stage three of EMU, when a common framework will be adopted. This underlies some of the recent changes implemented by the **Austrian National Bank**. More generally, however, the process takes root in the increasing convergence and globalisation of financial markets and structures, as most vividly illustrated by the generalised growth of repo markets. While national specificities will no doubt persist, the common elements in the institutional environment should gain further ground.

As regards specific forces underlying the direction of change, the **BIS** paper conjectures that an important structural factor shaping policy implementation is likely to be changes in payment and settlement arrangements. The paper draws attention not so much to the spread of retail electronic money as to the widespread introduction of real-time gross settlement (RTGS) and tighter risk control measures in the wholesale segments.

In the near future, these developments are seen as implying only comparatively minor modifications in operating procedures; the papers by the **Bank of Japan**, **Bank of France**, **Bank of England** and **Bank of Spain** give some consideration to these. The modifications relate mainly to the choice of mechanisms for granting the intraday credit generally provided for the smooth running of the systems and the timing and frequency of operations, especially to the extent that the demand for end-of-day working balances is affected. Even so, the **BIS** paper notes that the implications could be more significant when liquidity management operations come under strain, as during severe pressure on exchange rate commitments. On those occasions, limits on the availability and efficient redistribution of collateral could be tested. In addition, the arrangements should have sufficient safeguards for preventing undesired spillovers from intraday into overnight credit.

Looking much further into the future, it is possible to conceive of a world in which RTGS, together with the feasibility of settling transactions at any time during 24-hour cycles in various currencies, could effectively blur the distinction between "intraday" and overnight central bank credit, with arbitrage between the two no longer allowing the central bank to set separately the terms on which it granted funds. In that case, key maturity intervals and implementation strategies would presumably need to be reconsidered, as a continuous yield curve spanning "intraday" and longer maturities would emerge. While such a world is still well beyond the horizon, it appears to be a natural development in the wake of the changes taking place in financial markets under the impetus of technological advances.

Participants in the meeting

Australia:	Mr. Ric BATTELLINO Dr. Phillip LOWE
Austria:	Dr. Michael PFEIFFER Mrs. Margarethe QUEHENBERGER
Belgium:	Mr. Vincent PÉRILLEUX Mr. Ivo MAES
Canada:	Mr. Kevin CLINTON Mr. Mark ZELMER
France:	Mr. Yves NACHBAUR Mr. Christian PFISTER
Germany:	Mr. Peter SCHMID Mr. Henner ASCHE
Italy:	Mr. Eugenio GAIOTTI Mr. Paolo DEL GIOVANE
Japan:	Mr. Masayuki MATSUSHIMA Mr. Kazuhiko ISHIDA
Netherlands:	Dr. Job SWANK Mrs. Lidwin VAN VELDEN
Spain:	Mr. José VIÑALS Ms. Eloisa ORTEGA
Sweden:	Mr. Peter SELLIN Ms. Kerstin MITLID
Switzerland:	Dr. Erich SPÖRNDLI Mr. Dewet MOSER
United Kingdom:	Mr. Creon BUTLER Mr. Roger CLEWS
United States:	Mr. Paul BENNETT *(New York)* Mr. William WHITESELL *(Washington)* Ms. Carol BERTAUT *(Washington)*
BIS:	Mr. William WHITE Mr. Renato FILOSA Mr. Zenta NAKAJIMA Mr. Joseph BISIGNANO Mr. Palle ANDERSEN Mr. Claudio BORIO

Instruments, procedures and strategies of monetary policy: an assessment of possible relationships for 21 OECD countries

Job Swank and Lidwin van Velden[1]

Introduction

There is a wide variety in the choice of instruments, operating procedures and strategies of monetary policy by central banks (see Borio, 1996). This raises the questions whether there is a relationship between these aspects of monetary policy and whether the specific choice of instruments and procedures affects the central bank's ability to attain its operational target. For example, does the choice of monetary strategy imply a high or low frequency of open-market operations? Has the choice of monetary strategy a bearing on the precision with which short-term market interest rates are controlled by the central bank? Does a country's inflation history make it easier for the central bank to control short-term market interest rates? These questions are at the heart of this paper, which is organised as follows. Section 1 gives a brief overview of the monetary strategies, instruments and operating procedures used by the central banks in 21 OECD countries. Section 2 tries to uncover the operational target of the central banks in these countries. In Section 3, possible reasons for the existence of a relationship between the instruments, procedures, strategy, interest rate control of the central bank and its track record in terms of inflation performance are considered. Section 4 tries to find out whether the above-mentioned relationships can be inferred from a small and simple data set which is indicative of monetary policy procedures, strategies, interest rate control and the inflation performances for the group of OECD countries. The final section concludes.

1. An overview of monetary policy aspects in 21 OECD countries

It is common practice to make a distinction between monetary strategy (i.e. the way in which a central bank aims at achieving its final objective(s)), operating procedures and instruments. In practice, four *monetary strategies* can be distinguished. The first is monetary targeting, in which monetary policy is geared to a publicly announced intermediate monetary target. This strategy was adopted by many countries in the second half of the seventies. However, during the eighties, monetary targeting was burdened, in a number of countries, by instability of money demand functions due to financial deregulation and innovation (Goodhart, 1989). In recent years, some of these countries switched to a strategy of direct inflation targeting, in which explicit inflation targets are publicly announced (New Zealand, Canada, Australia, the United Kingdom, Sweden, Finland and Spain). Other countries adopted a strategy based on a wide range of monetary indicators (the United States and Japan). The strategy of monetary targeting is still in use in Germany, Greece, Italy and Switzerland. In most smaller European countries, the central banks focus on exchange rates as intermediate targets (see Table 1).

The monetary policies of central banks also show marked differences in the use of operating procedures and instruments. *Operating procedures* refer to the choice of the operational target, the frequency of open-market operations, the use and width of a corridor for market interest rates, and the way of signalling policy intentions. Most central banks focus on a short-term market

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1 Monetary & economic policy department and Financial markets department respectively. We would like to thank the participants of the Autumn Meeting of BIS Central Bank Economists 28th-29th October 1996 for their comments on an earlier version of this paper. The assistance of Martin Admiraal in collecting the data is gratefully acknowledged.

Table 1
Instruments, procedures and strategies of monetary policy in 21 OECD countries

	Monetary strategy	Interest rate corridor (distance +/-)	Frequency of operations (every x days)	Averaging facility
Australia	p		1	
Austria	er	+/- (1.25-2.25%)	7	X
Belgium	er	+/- (2.5-4.0%)	1	
Canada	p	+/- (0.5%)	1	
Denmark	er	-	7	X
Finland	p/er	+/- (4.0%)	4	X
France	er	+	1	X
Germany	M	+/- (1.0-2.0%)	7	X
Greece	M	+/- (3.0-4.0%)	1	X
Ireland	er	+/- (3.25%)	1	
Italy	M	+/- (1.0-1.5%)	4	X
Japan	E		1	X
Netherlands	er	-	4	X
New Zealand	p		1	
Norway	er	+/- (2.0%)	2	
Portugal	er	+/- (2.25-3.00%)	2	X
Spain	p/er		1	X
Sweden	p/er	+/- (1.5-2.0%)	1	
Switzerland	M	+/- (2.0-3.0%)	1	
United Kingdom	p		< 1	
United States	E		2	X

Notation: p: inflation targeting; M: monetary targeting; er: exchange rate target; E: eclectic strategy; +: ceiling for market rates; –: floor for market rates.

interest rate as operational target, although it is often unclear which specific interest rate (overnight or 1-month) performs that role. Neither does there exist a clear connection between the interest rate targeted and the maturity of open-market operations carried out by the central bank. Interest rate steering can be done, at one extreme, through a narrow interest rate corridor, bounded by the interest rates on the central bank's standing facilities or, at the other extreme, by relying on open-market operations exclusively. The first alternative tends to result in a low level of market activity, as market participants are deprived of an incentive to trade in markets. In the second alternative, on the other hand, a high frequency of central bank intervention in the money market is called for so as to avoid large fluctuations in short-term market interest rates.

As is well-known, there is a general tendency towards greater market orientation and greater monetary policy flexibility in the Western industrialised countries (Laurens (1994), p. 3). As a result, in most of these countries, open-market operations have become the major instrument for providing liquidity and controlling short-term market interest rates. This is sometimes combined with a wide interest rate corridor.[2] In other countries, only an upper or a lower limit for short-term market interest rates is set. The use of both intervention rates (on open-market operations) and official rates (on standing facilities) increases the central bank's scope for signalling its strategy. The desire for greater flexibility in interest rate steering has been ascribed to the integration of financial markets and the responses of market interest rates to changes in expectations and developments in economic fundamentals and policy (Kneeshaw and van den Bergh (1989), p. 9). A more recent trend is that

2 Canada is the only country with a narrow interest rate corridor.

central banks become more and more transparent in signalling the desired level of interest rates. For example, the United States and the United Kingdom have started to announce their target short-term market interest rates, while the Bundesbank makes more frequent use of fixed rate tenders for open-market operations. As appears from Table 1, the frequency of open market operations varies from a couple of times a day (the United Kingdom) to only once a week (Germany).

For the group of countries considered, the following instruments of monetary policy and their functions can be distinguished:

- Reserve requirements, obliging institutions to hold an amount of money on an account with the central bank, with the aim of absorbing liquidity in the money market and/or augmenting control over money growth (monetary control).
- Standing facilities for the (automatic) provision or withdrawal of liquidity at the end of the day at rates forming the ceiling and the floor, respectively, for short-term market interest rates.
- Open-market operations; i.e. transactions effected by the central bank at its own initiative to steer interest rates, possibly within a corridor formed by the rates on the central bank's standing facilities.
- Averaging provisions for the automatic stabilisation of short-term interest rates. In most countries, these provisions are embedded in reserve requirements. An averaging provision attached to reserve requirements offers institutions the opportunity to vary the daily amount held on a reserve account at their own discretion, so long as the requirement is met on average for the period as a whole. The averaging provision absorbs fluctuations in liquidity needs both at an individual and at the macroeconomic level; in effect, it widens the scope for banks to actively manage their liquidity and thereby smoothes (very) short-term interest rates over the greater part of the maintenance period.

2. The revealed operational target

The operational target can be defined as the objective variable which is not directly steered by the central bank but which it can control with relatively great precision. It is obvious that this variable is somewhere at the beginning of the monetary transmission process; that is, somewhere between the central bank's intervention rate (on open-market operations) and its intermediate target (if any) such as, for example, the exchange rate or a monetary aggregate. Since nowadays the majority of central banks in the OECD-region pursue interest-rate operating procedures (Kasman (1992)), the typical operational target is a short-term market interest rate. While most of these central banks are not very specific about the precise short-term market interest rate they are targeting, this issue can be examined in an ex post sense; that is, by looking at the differences central banks have actually allowed to occur over a certain period of time between their intervention rates, on the one hand, and alternative short-term market interest rates, on the other.

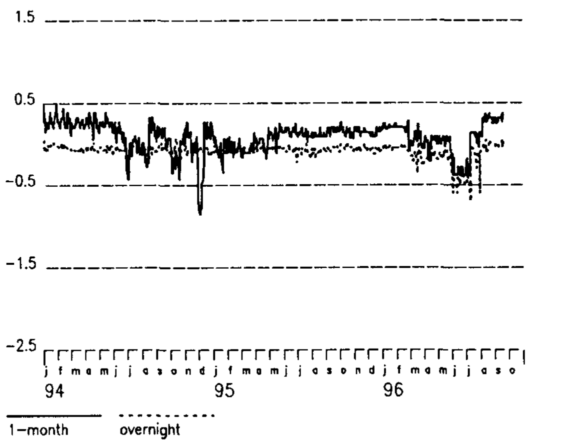
Judging from Figure 1 and the standard deviations in Table 2, about half of central banks tend to focus on the overnight market rate and half of them have a revealed preference for targeting the 1-month rate, although it is fair to say that the differences between the two standard deviations are not always substantial. Notable overnight-rate targeters are the central banks of Australia, Belgium, New Zealand, Spain and Sweden, all of which happen to intervene quite frequently in the open market.[3] Moreover, reserve requirements (with averaging provisions) are absent in these countries, except for Spain, implying that overnight market rates do not tend to peak at the end of maintenance periods. The central banks of Austria and the Netherlands manage to have close control over both the

[3] New Zealand is a special case in that the Reserve Bank of New Zealand (RBNZ) pursues a reserves operating procedure, so that the RBNZ's intervention rate naturally tends to be close to market rates.

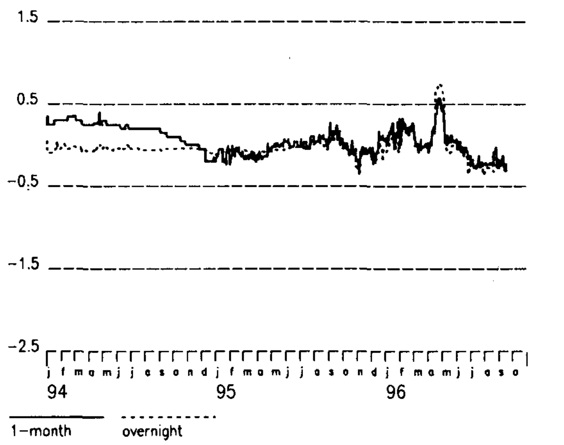
Chart 1

Differential of the intervention rate with the overnight and 1-month interest rate

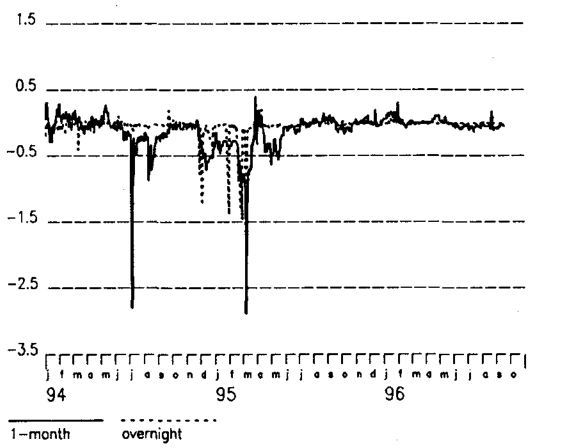
Australia
Daily rates



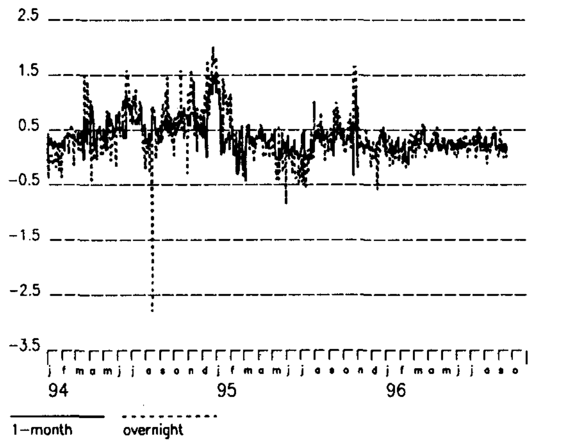
Austria
Daily rates



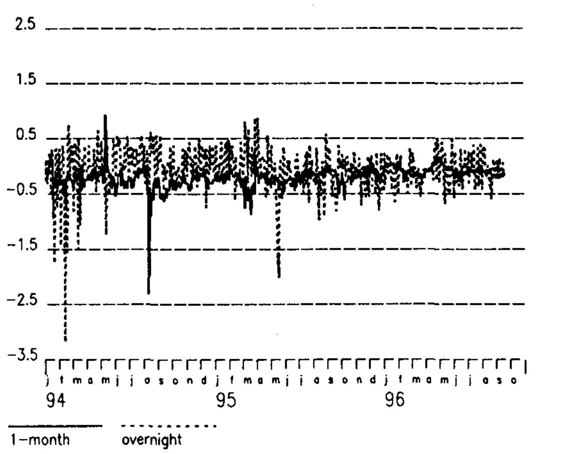
Belgium
Daily rates



Canada
Daily rates



Denmark
Daily rates



Finland
Daily rates

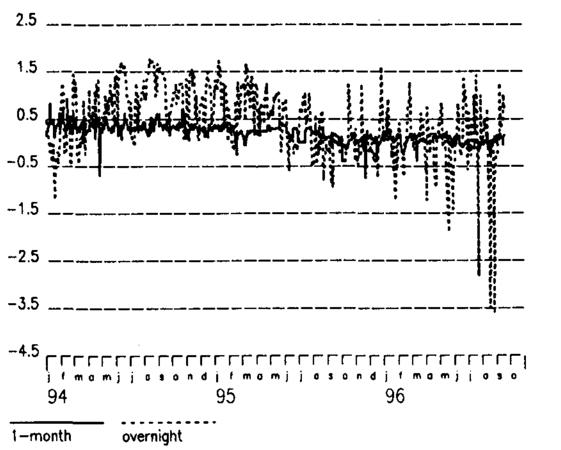
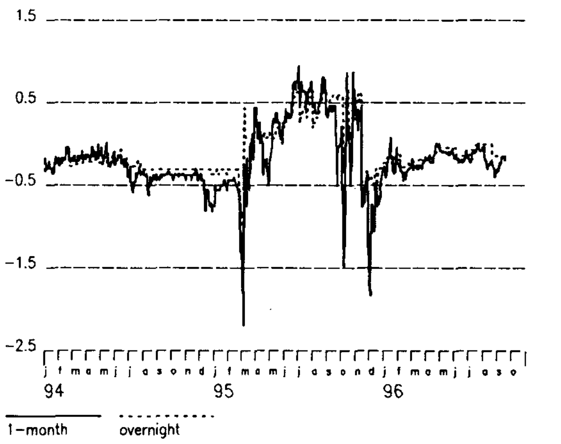


Chart 1 (cont.)

Differential of the intervention rate with the overnight and 1-month interest rate

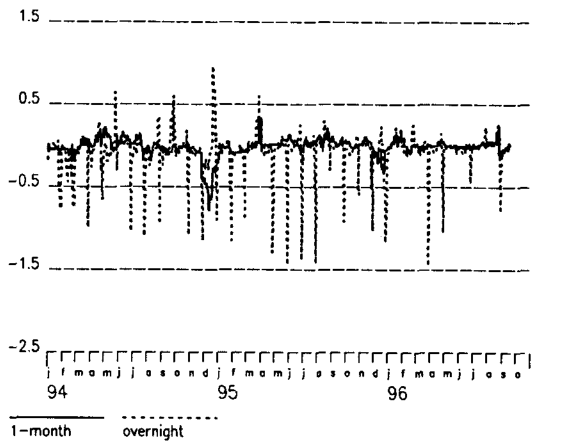
France

Daily rates



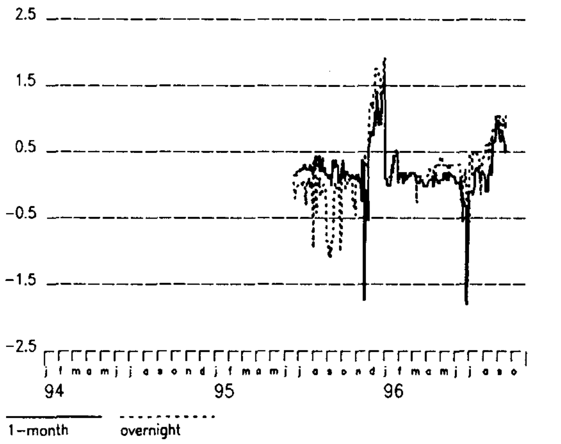
Germany

Daily rates



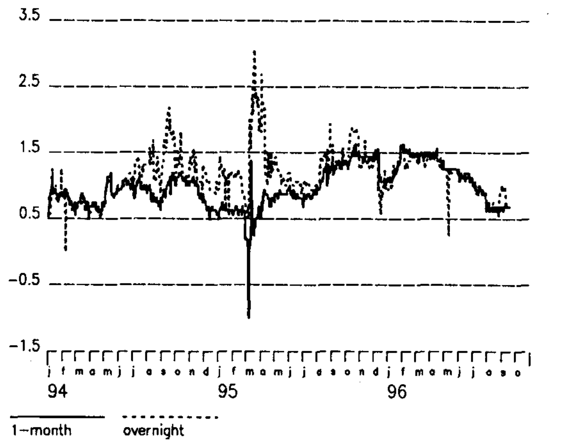
Greece

Daily rates



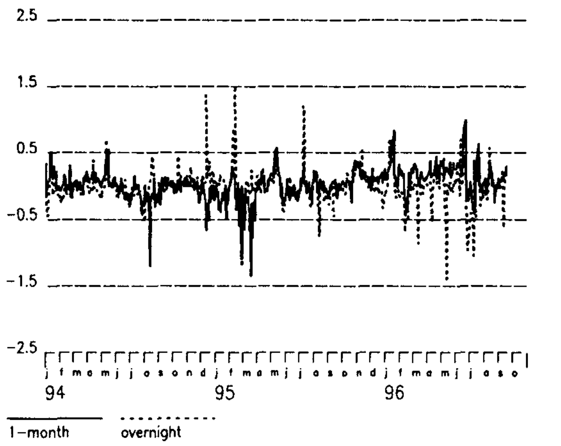
Ireland

Daily rates



Italie

Daily rates



Japan

Daily rates, vis a vis Discount rate

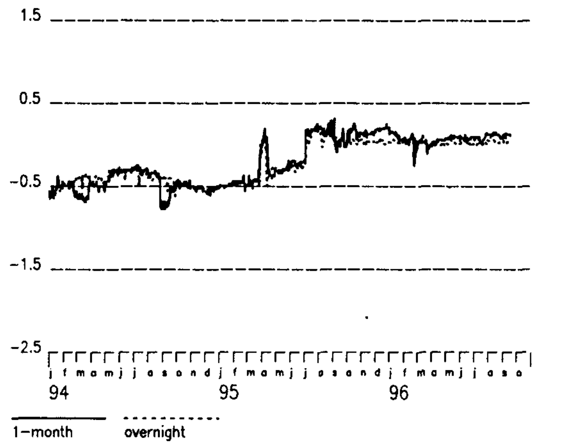
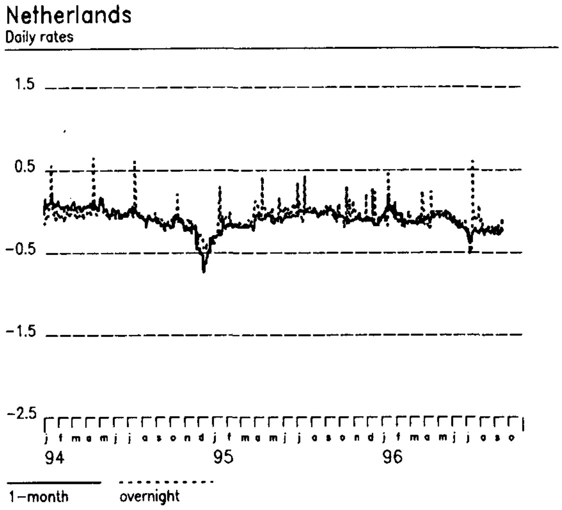
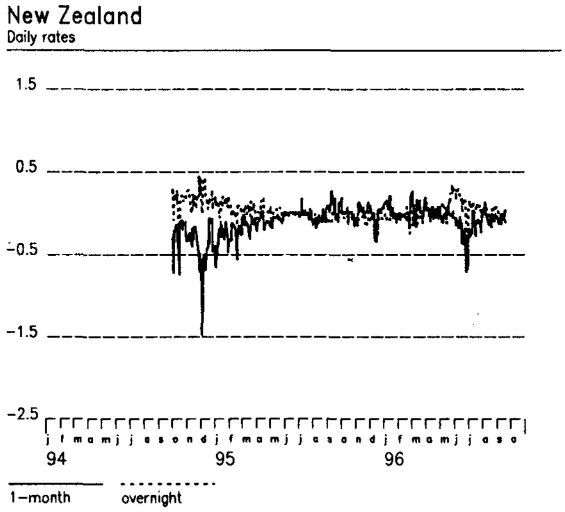
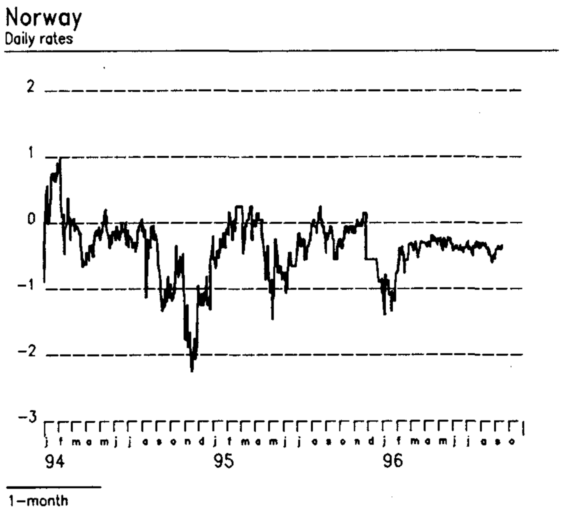


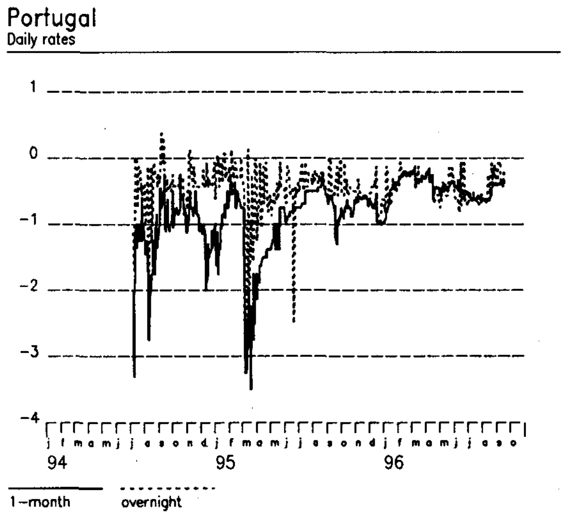
Chart 1 (cont.)

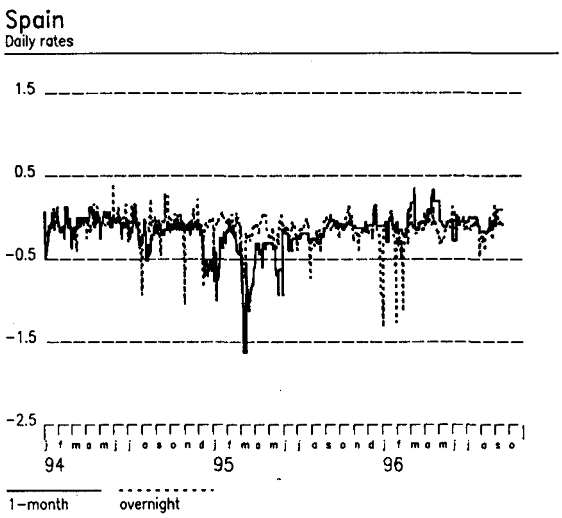
Differential of the intervention rate with the overnight and 1-month interest rate











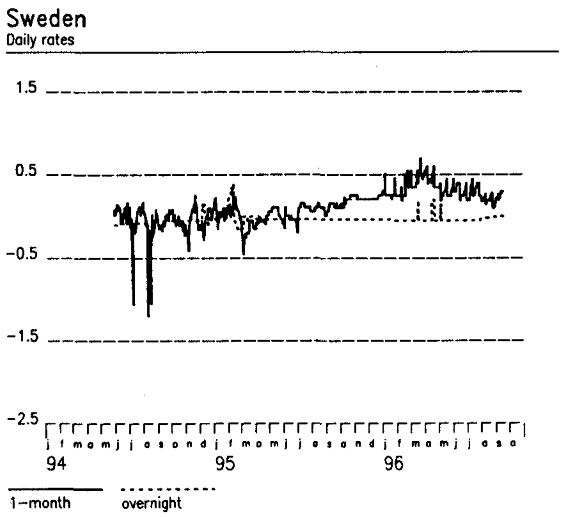
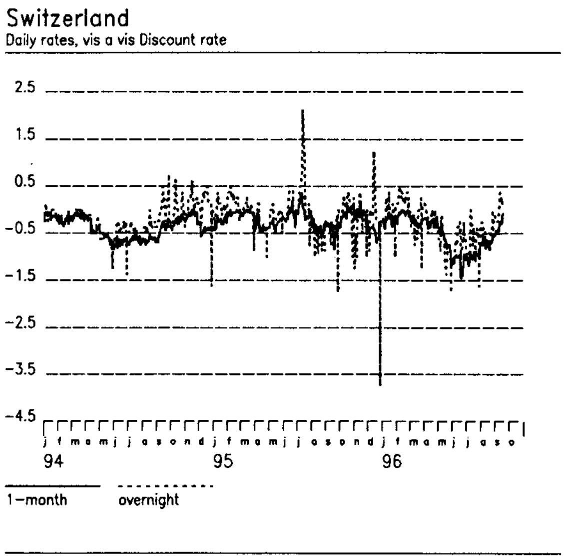
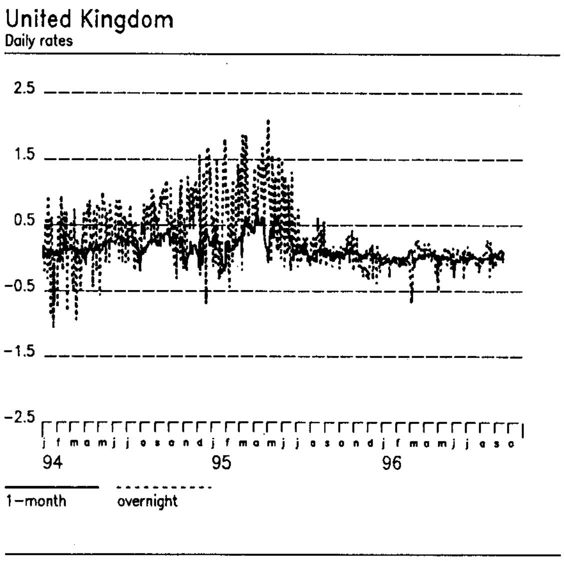
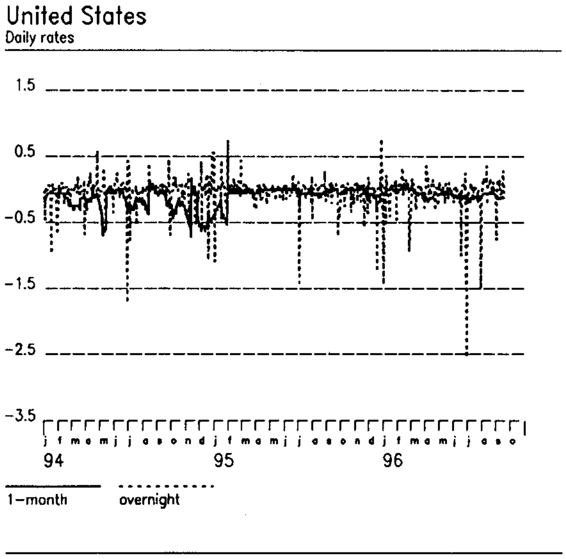


Chart 1 (cont.)
Differential of the intervention rate with the overnight and 1-month interest rate







overnight market rate and the 1-month rate. A tentative explanation of this finding is that the exchange rate policies of both countries have been highly successful for years now, so that the interest rate signals of the two central banks are perhaps more credible and, hence, more directional to interbank rates than in other countries.

Another interesting observation is that the revealed operational target for some countries does not coincide with the operational target on which central banks say they are focusing. For example, the revealed operational target of countries like the United States, Switzerland, Italy and Germany is the one-month rate, while they focus on the overnight rate. For some countries, our findings could perhaps be explained by the fact that the liquidity in the overnight market is considerably larger than in the market for one month maturities. Furthermore, changes in the overnight rate which are considered to be of a technical and short-term nature will not influence longer-term rates.

Table 2

Short-term interest rate control and inflation performance in 21 OECD countries

	Standard deviation of differential between intervention rate[1] and the		Average inflation rate 1990-93
	overnight rate	1-month rate	
Australia	0.096*	0.188	3.336
Austria	0.142*	0.177	3.563
Belgium	0.162*	0.272	2.963
Canada	0.430	0.258*	3.436
Denmark	0.379	0.176*	2.100
Finland	0.697	0.179*	3.898
France	0.299*	0.389	2.721
Germany	0.250	0.112*	3.482
Greece	0.515	0.378*	17.562
Ireland	0.365	0.316*	2.762
Italy	0.246	0.229*	5.547
Japan[2]	0.244*	0.293	2.330
Netherlands	0.137	0.130*	2.940
New Zealand	0.117*	0.185	2.768
Norway	–	0.452	3.039
Portugal	0.377*	0.519	10.054
Spain	0.168*	0.234	5.792
Sweden	0.056*	0.203	6.692
Switzerland[2]	0.427	0.287*	4.653
United Kingdom	0.484	0.158*	5.652
United States	0.244	0.139*	3.907

* denotes the lowest of the two standard deviations.

[1] For Japan and Switzerland the discount rate is used as the intervention rate. [2] Standard deviations are calculated on the basis of daily figures for the period January 1994-October 1996. For Greece, New Zealand, Portugal and Sweden, shorter periods are used because of changes in instruments or operating procedures.

3. Some preliminary notions on the relationship between instruments, procedures, strategies and interest rate control

The following relationships between monetary strategy, instruments, procedures, short-term interest rate control and inflation performance are conceivable:

- If daily money market operations are uncalled for, the set of instruments may need to include facilities which are activated at the initiative of the banks, such as standing facilities and averaging provisions, in order to smooth short-term market interest rates in an automatic way. However, the chosen frequency of open-market operations may also depend on the volatility and predictability of the autonomous factors affecting money market liquidity (banknotes in circulation, Treasury balance), the likelihood of misinterpretation of signals in case of frequent operations and the extent to which the central bank wants to contain interest rate volatility. Bernanke and Mishkin ((1992), pp. 36-37) state that "interest rate stability has also in many cases been an independent objective of policy". It is suggested that central banks view interest rate stability as important for maintaining orderly financial markets free from excessive speculation. In this respect, a distinction should be made between short-term market interest rates and longer-term market interest rates. A high volatility in the very short-term rates does not necessarily imply a high volatility in the longer-term rates, which tend to be more relevant to the stability of the financial system (Bernanke and Mishkin (1992), p. 49). The desirability of low volatility in interest rates may also be one of the reasons why central banks prefer gradual interest rate changes (Goodhart (1995)). Goodhart (op. cit., p. 16) finds in his sample of major countries that the pattern of interest rate adjustments by central banks involves a sequence of small changes in interest rates of the same sign, occurring with relatively small durations between such changes. Although Goodhart (p. 20) describes the interest rate policies of the major countries as "too little too late" to hold inflation on a desired path, one of his empirical findings is that this behaviour does not seem to be closely related to overall counterinflationary success. One possible explanation is that the predictability of long continued sequences of changes in short-term interest rates allows longer-term rates to adjust more rapidly, because longer-term rates reflect the expected future central bank and short-term market rates. And output and prices mainly respond to these longer-term rates.

- Central banks pursuing a strict exchange rate target have to attune their interest rates quite closely to the interest rate of the anchor country and might therefore have to operate more frequently in the money market than central banks with a monetary target, which tend to have a medium-term orientation of monetary policy. Also, central banks in countries where short-term interest rate changes are transmitted quickly to the real economy (the United Kingdom, Finland and Italy) may be expected to have a desire to control short-term market interest rates quite closely. Finally, if central banks apply an eclectic strategy without announcing indirect or direct targets, this may increase the need for transparency of monetary policy through a closer steering of interest rates.
- One might conjecture that there is a relation between a central bank's choice of operating procedures, on the one hand, and its strategy and track record, on the other. For example, the extent to which a central bank is able to control variables further on in the monetary transmission process on a day-to-day basis determines, *inter alia*, the precision and the success with which intermediate and final objectives can be realised.
- The extent to which short-term market interest rates are controlled may depend on the central bank's track record in keeping inflation low. The idea is that the market is more receptive to the central bank's interest rate signals if the central bank is more credible and credibility depends on past inflation performance.

4. Empirical evidence on the relationship between instruments, procedures, strategies and interest rate control

The aim of this section is to find out whether the relationships described in Section 3 can be inferred from a small and simple data set which is indicative of monetary policy procedures and the inflation performances of 21 central banks in the OECD region (see Tables 1 and 2). The following questions are raised:

- What is the relation between instruments, procedures and strategies of monetary policy (monetary policy aspects)?
- What is the relation between the aspects of monetary policy and the control over short-term market interest rates?
- What is the relation between the control over short-term market interest rates and the central bank's track record in terms of inflation performance?

4.1 Instruments, procedures and strategies

There seems to exist a relationship between the inclusion of an averaging provision within the set of instruments and the frequency of open-market operations. All the central banks intervening every four days or less frequently, have included an averaging provision in their sets of instruments. On the other hand, countries like Spain, Portugal and France have averaging provisions as well but are still active on a daily basis. Probably, in these countries the room for manoeuvre the averaging provisions provide to the banking system is limited because of a relatively short averaging period or a low level of reserve requirements.

All countries pursuing a monetary targeting strategy set an interest rate corridor for market rates. This may be explained by the medium-term orientation of such a strategy. By means of the official rates for the floor and ceiling the medium-term stance of monetary policy can be signalled.

All the inflation targeters operate in the market every day, except for Finland which pursues both an exchange rate target and an inflation target and operated on a daily basis before the introduction of an averaging facility into the set of instruments in May 1996. However, there does not seem to be a relationship between the strategy of direct inflation targeting and the high frequency of operations, because most countries did not change their operating procedures when switching to this strategy.

For the group of countries pursuing an exchange rate target, the frequency of intervention varies from daily to once a week. So, the proposition that exchange rate targeters operate more frequently does not emerge from empirical evidence.

4.2 Monetary policy aspects and the control over the operational target

A comparison of Tables 1 and 2 does not reveal a clear relation between a central bank's control over short-term market interest rates, on the one hand, and its set of instruments and operating procedures, on the other. For example, judging by the huge differences in standard deviations between Australia and Greece a high frequency of open-market operations does not tell a lot about the central bank's control over short-term market interest rates, nor does the presence of an interest rate corridor or an averaging provision.[4] Other factors are perhaps more relevant, one of which may be central bank credibility, as the standard deviations for Germany seem to indicate.

4.3 Short-term interest rate control and the strategy of monetary policy

Recalling the brief discussion on monetary policy strategy in Section 3, we would expect exchange rate targeters to have close control over short-term market interest rates, whereas money targeters, for example, could permit themselves to leave some scope to the market in the determination of short-term interest rates. As appears from Table 3, this conjecture does not seem to be supported by the empirical evidence. While there are a number of exchange rate targeters which closely control at least one short-term market interest rate (Austria, Belgium, Denmark and the Netherlands), others, such as Ireland and Portugal, tend to have larger differences between intervention and market interest rates. It should be noted in passing, though, that the first group of exchange rate targeters includes countries which have tightly linked their currencies to the Deutsche mark for years now. Hence, there might be a significant relation between the precision with which the exchange rate target is hit and the precision with which short-term market interest rates are controlled, but this is beyond the scope of the present paper.

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4 Regressions of the respective standard deviations on the frequency of open-market operations and a dummy capturing the presence of an averaging facility did not point to a significant relationship.

Table 3

Short-term interest rate control according to monetary policy strategy

	Lowest and highest standard deviation of differential between intervention rate and the	
	overnight rate	**1-month rate**
Money targeters	0.25 - 0.52	0.11 - 0.38
Exchange rate targeters	0.14 - 0.38	0.13 - 0.52
Inflation targeters	0.06 - 0.70	0.16 - 0.26
Eclectic central banks	0.24	0.14 - 0.29

Another conclusion that emerges from Table 3 is that both inflation targeters and eclectic central banks tend to have close control over the 1-month rate. This would suggest that this rate plays a more prominent role in the monetary transmission process in these countries than in countries where the central bank pursues a monetary or exchange rate target.

4.4 Short-term interest rate control and inflation performance

We have tried to test the proposition that the extent to which short-term market interest rates are controlled depends, ceteris paribus, on the central bank's track record in keeping inflation low. The idea is that the market is more receptive to the central bank's interest rate signals when the central bank is more credible, with credibility measured by past inflation performance. It is rather difficult to capture the ceteris paribus clause, since data on the frequency of open-market operations, averaging provisions, monetary policy strategies, etc., are not measured on similar scales. Our test, which simply consists of correlation coefficients between the standard deviations in Table 2 and average inflation rates over the period 1990-93, is therefore a very crude one.

Table 4

Correlation coefficients between measures of short-term interest rate control and inflation performance

	Standard deviation of differential between intervention rate and the	
	overnight rate	**1-month rate**
Average inflation rate over 1990-93	0.31	0.49

Table 4 shows that there does seem to exist a relationship between interest rate controllability and the central bank's inflation record. However, only the correlation coefficient for the 1-month rate is significant (at the 5%-level). This seems quite plausible, since variations in the overnight rate vis-à-vis the intervention rate are also due to a number of other, probably more important, factors, falling under the ceteris paribus clause. It should be noted, though, that the significance of the latter correlation coefficient is contingent on the inclusion of Greece and Portugal in the sample, which are the countries with the highest inflation rates.

Conclusions

In this paper, the relationship between instruments, operating procedures, monetary strategies and the central bank's ability to control the operational target is considered. Our results, based on a small and simple data set, indicate the following tentative conclusions:

- There exists no clear relation between a central bank's monetary strategy, on the one hand, and its set of instruments and operating procedures, on the other. Presumably, differences in instruments and operating procedures employed by central banks stem not so much from differences in monetary strategy as from differences in tradition and financial structure (type/number of credit institutions, degree of market concentration, the existence and liquidity of particular financial markets, etc.).
- Differences in control over short-term interest rates cannot be explained by differences in instruments, procedures and strategies. A more relevant factor might be central bank credibility.
- Both inflation targeters and eclectic central banks tend to have close control over the 1-month rate, which suggests that this rate plays a more prominent role in the monetary transmission process in these countries than in countries where the central bank pursues a monetary or exchange rate target.
- As expected, a number of central banks targeting exchange rates have close control over at least one short-term market interest rate. This group includes countries which have tightly linked their currencies to the Deutsche mark for years. Apparently, the precision with which the exchange rate target is hit has a bearing on the precision with which short-term market interest rates are controlled.
- There is some evidence of a significant relationship between controllability of the 1-month interest rate and the central bank's inflation record.

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Monetary policy execution in Spain: key features and assessment[1]

Alberto Cabrero, Jose Luis Escrivá and Eloísa Ortega

Introduction

The model used by the Banco de España to execute its monetary policy over the past ten years has evolved in line with the type of changes made at other central banks. Thus, since the late eighties, the Banco de España has oriented its market interventions towards using the overnight interbank rate as the operational target to guide short-term monetary policy actions. At the same time, open market operations have progressively gained in importance over this period, becoming the dominant procedure in monetary implementation techniques, while the relative significance of the reserve requirement has tended gradually to diminish.[2]

The reasons behind these changes are largely common to a number of countries, and are related, above all, to the liberalisation, integration and globalisation of financial markets at the international level. Nonetheless, the Spanish model displays certain particularities which are in response to the conditioning factors of the Spanish operational framework. Notable among these idiosyncratic features are the non-existence of credit and deposit facilities, a relatively high degree of activism in intervention by the Banco de España and the use of the principle of liquidity (and obviously, of quality as well) in selecting the collateral that is valid for financing operations with the Banco de España.

The aim of this paper is to present the Spanish monetary implementation model, to explain its conditioning factors and particularities and to evaluate its degree of effectiveness in fulfilling the functions assigned to it. Hence, the following section describes the operational framework used by the Banco de España for monetary policy implementation. In connection with its conditioning factors, there is discussion, first, of the changes in the economic and financial framework and, second, of some of the characteristics of the Banco de España balance sheet. In this respect, particular regard is paid to the liquidity generating autonomous factors. The second section evaluates the capacity of the Banco de España to steer – with the procedures available to it – short-term interest rates, and it analyses the combination of instruments used to this end. The third section draws conclusions and is followed by an annex in which a theoretical model and some empirical evidence on the functioning of the Spanish overnight interbank market is presented. Particular attention is paid in this annex to the modelling of banks' demand for bank reserves in a setting with compulsory reserve requirement.

1. Monetary policy implementation in Spain

1.1 The operational framework

The operational framework used by the Banco de España for implementing monetary policy is based on a very strict application of market criteria. This gives rise to a relatively straightforward and transparent system in which open market operations are the centrepiece for the

1 We are grateful to Fernando Gutiérrez for comments to a previous version of this paper and to Miguel Val for providing us information used in the paper. Any errors are our own.

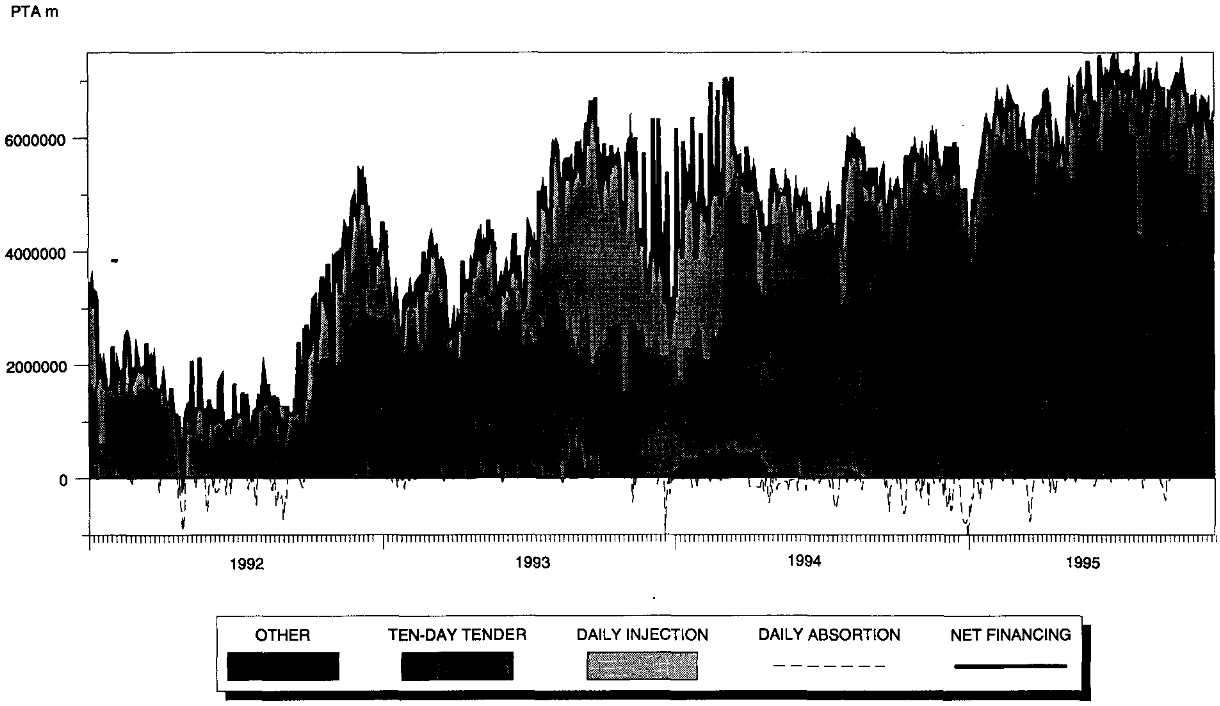
2 On the use of open market operations in EU countries, see Aspetsberber (1995).

regulation of money market liquidity conditions. In addition, there is a non-remunerated reserve requirement which affects all credit institutions. It is set at a relatively low level (2% in recent years) and is designed with a view to assisting the liquidity management of both the Banco de España and of its counterparties. In principle, the reserve requirements (RRs) contribute to stabilising credit institutions' demand for liquidity and, indirectly, to reducing short-term interest rate volatility.[3]

The Banco de España regulates money market liquidity conditions through the close adjustment of interest rates in the shortest-dated money market terms (between one and ten days). Such intervention is structured around two major types of open market operations. First, via the calling of a ten-day repurchase tender for Banco de España certificates (CEBES by their Spanish name) and government debt in which all entities subject to RRs participate. And second, via a daily presence of the Banco de España in the markets using repo operations to inject and drain off liquidity. The same type of collateral is used as for the ten-day tender, albeit with an overnight maturity and with a limited group of entities.[4]

At the regular tenders held every ten days, the central bank supplies most of the liquidity entities will need for that period, the estimation of which is based on the foreseeable course of the autonomous factors and on the average required reserves (see Chart 1). Indeed, this type of operation is conducted in accordance with a pre-set schedule closely linked to RRs.[5] Moreover, it is in these operations that the official Banco de España interest rate is determined, through which the central bank signals the desired monetary policy stance.

Chart 1
Banco de España financing to the banking system
1992-95



Source: Banco de España.

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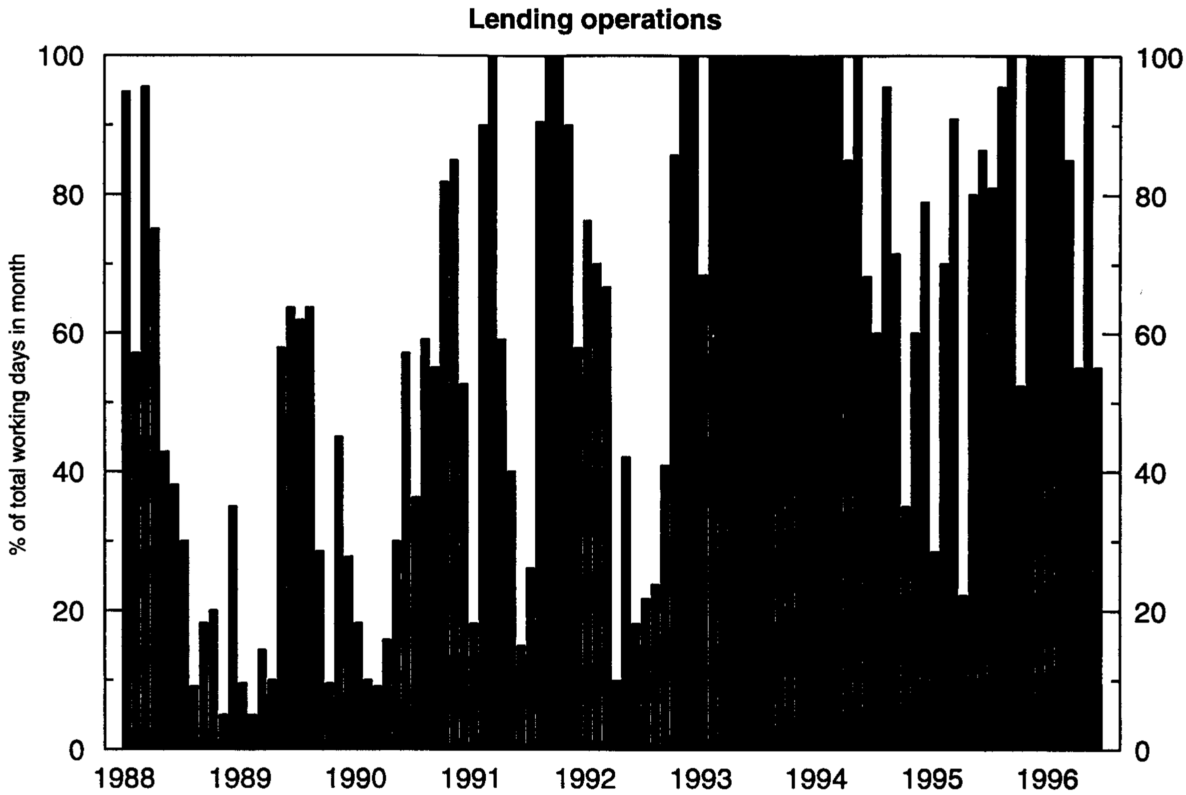
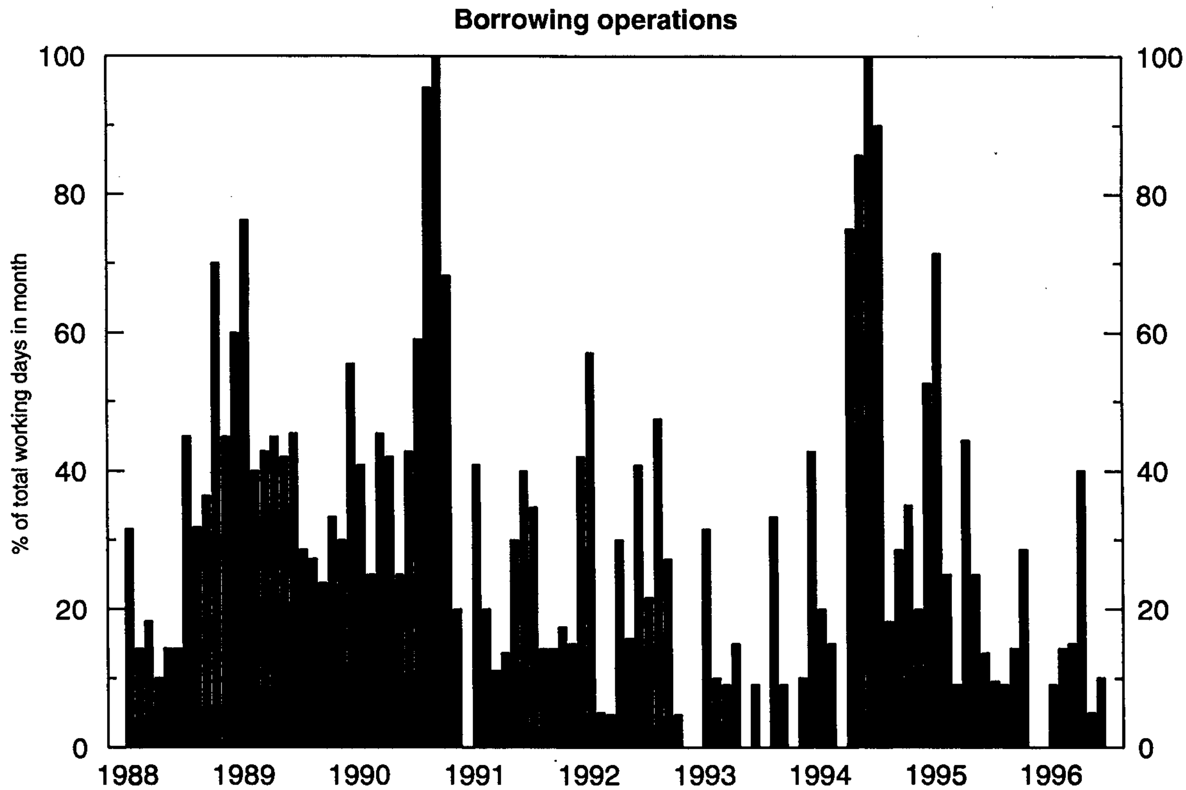
3 A more detailed description of the Banco de España monetary policy execution can be found in Ortega and Quirós (1996).

4 For a more comprehensive explanation, see "Banco de España's replies to the BIS questionnaire on Central Bank monetary policy operating procedures".

5 Ten days is the frequency of the computation and maintenance period of RRs.

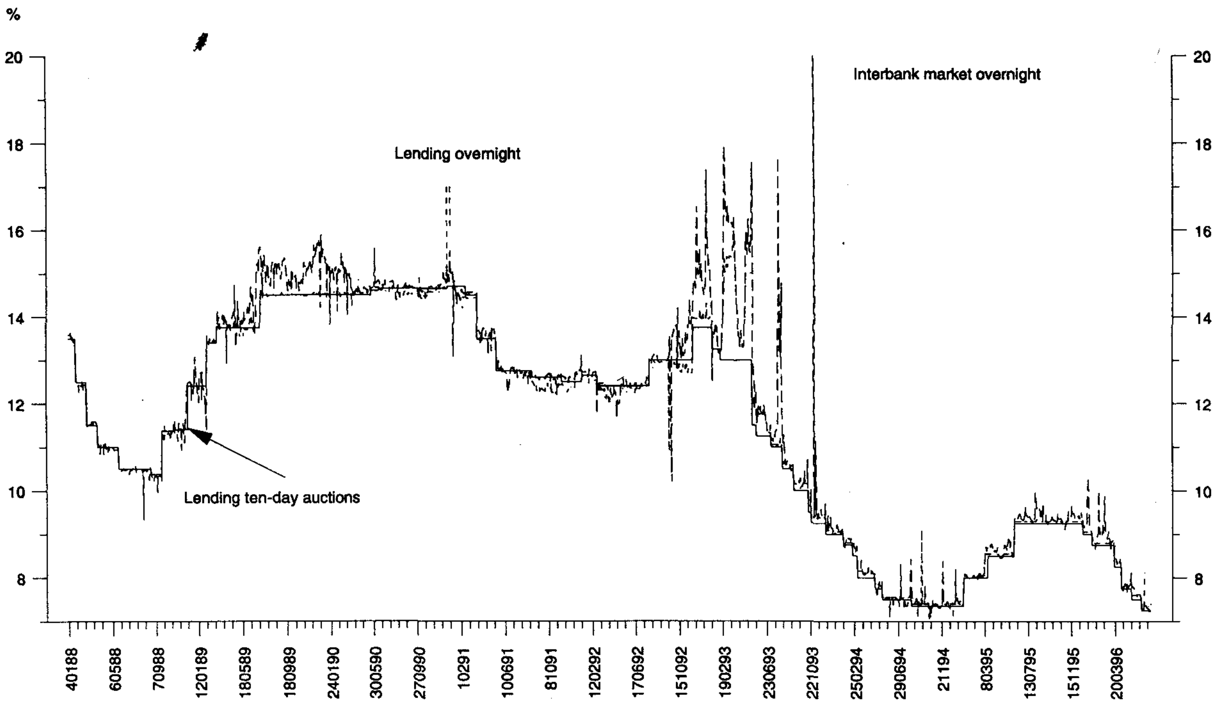
Chart 2
Frequency of Banco de España daily interventions





Daily fine-tuning operations are concentrated in the more liquid segments of the interbank deposit market (normally an overnight maturity). The aim of this type of intervention is to keep the overnight interest rate within a very narrow corridor. However, this entails a very active intervention by the Banco de España in the money markets (see Chart 2). As a result of this strategy the daily intervention rate pivots around the ten-day rate, and only in exceptional circumstances – normally associated with exchange rate tensions – does the Banco de España make differentiated use of daily and ten-day rates (see Chart 3). The volatility of daily rates is, likewise, very low.

Chart 3
Banco de España and interbank deposit market interest rates



RRs are an essential element within the Banco de España's operational framework and play an important role in the functioning of the Spanish money market. However, the functions performed by this instrument have been changing over time. In the eighties, under a quantity operational target, RRs were crucial in defining a stable short-run money multiplier which allowed the Banco de España to pursue reserve paths coherent with the M4 objectives. Moreover, the high reserve ratios prevailing at that time were warranted by the need to enlarge banks' demand for reserves, thereby modifying the sign – from deficit to surplus – of the net financial position of the Banco de España vis-à-vis the banking system. At present, the sharp changes in the structure of the Banco de España's balance-sheet have made this enlargement function of RRs redundant. This issue is discussed in greater detail in Section 1.2.2.

On the other hand, as a result of the gradual shift since the mid-eighties towards an interest-rate-based execution of monetary policy, the use of the money multiplier is being phased out. Nevertheless, under the new operational strategy aimed at reaching a high degree of stability in the short term for money market interest rates, RRs have also proved to be a very useful instrument. This stabilisation function crucially lies in the existence of averaging provisions meaning that banks are obliged to hold at the Banco de España non-remunerated reserves at an average level over a maintenance period of around ten days. Averaging provisions provide an automatic buffer-stock mechanism for controlling the volatility of the interest rates, as the effects of liquidity shocks on money market interest rates are absorbed by variations of reserve holdings which can be rebuilt or reduced during the remaining of the maintenance period.[6] A more formal presentation and some econometric results of the functioning of the Spanish market for bank reserves and of the repercussion for this market of the existence of averaging provisions can be found in the annex to this paper. In examining these repercussions, it is worth mentioning the fact that the performance of the RRs buffer-stock function is not uniform over time or across different circumstances.

First, in the absence of the Banco de España's fine-tuning operations, interest rate volatility would tend to follow a marked time pattern, rising sharply at the end of the maintenance period.[7] This is so because, as the reserve maintenance period progresses, the constraints posed by the overall reserve requirement and by previous decisions become progressively more binding, leaving banks less leeway to absorb money market shocks. As a result, the banks' demand for reserves becomes less elastic. At the limit, on the last day of the maintenance period, it is totally inelastic, as banks have practically no choice but to meet any unfulfilled portion of the overall reserve requirement. In this respect, it is important to notice that banks are not allowed to carry over reserves to the next maintenance period and that the penalties imposed by the Banco de España on banks incurring reserve deficiencies are extremely high. One implication of this pattern of interest rate volatility is a more active presence of the Banco de España in the money market by means of frequent fine-tuning operations towards the end of maintenance periods. The sign of these end-of-maintenance-period interventions is normally one of injecting liquidity.

Second, while RRs with averaging provisions facilitate the absorption of shocks to the liquidity autonomous factors, they also reinforce a potential source of interest rate volatility, i.e. changes in interest rate expectations. Banks' reserve management over the maintenance period is swayed by the arbitrage between the current overnight rate and the expected overnight rate over the remainder of the maintenance period – the spread between these two variables is the opportunity cost of holding reserves on each particular day. This arbitrage activity means that the overnight rate tends to settle at around the expected level. The implications of this behaviour are manifold. First, episodes of marked changes in interest rate expectations may cause undesired movements in the overnight rate. On these occasions, the existence of RRs reduces Banco de España's ability to offset the shift in the demand for reserves via fine-tuning operations. Second, the Banco de España, by targeting the overnight rate, is in practice targeting an interest rate with a maturity moving in line with the remaining duration of the maintenance period. Further, the information that can be extracted from overnight rate developments is modified by the presence of RRs with averaging provisions, to the extent that actual interest-rate fluctuations tend to respond less to autonomous shocks to the supply of reserves and more to expectations regarding future interest rates. Finally, insofar as the Banco de España influences short-run interest rate expectations according to its signalling strategy, RRs serve not only to smooth interest rates in the face of liquidity shocks, but also to steer the overnight rate through expectations.

1.2 Conditioning factors

This implementation framework has been in place without significant changes since the early 1990s. The change in the operational framework, however, came about gradually, during the second half of the 1980s, given the confluence of a series of factors which highlighted the advisability of making changes to the Banco de España's operational procedures. The culmination of these reforms was the transformation of RRs in 1990[8] complemented by the creation of the ten-day period repo

6 A discussion of the stabilisation function of reserve requirements can be found in Santos (1994).

7 Some evidence on this pattern is provided in Ayuso, Haldane and Restoy (1993).

8 As a result of this transformation, the reserve requirement was lowered by somewhat more than fifteen percentage points, and the banking assets freed following this reduction were allocated to the subscription of certificates issued by the Banco de España. This allowed a portfolio made up of CEBES (the Banco de España certificates) and

tenders and an increased recourse to daily fine-tuning operations. The presence at that time of a sufficiently developed government debt market, as the Book-Entry System for Government Debt Trading had been running for three years, was no doubt a factor that contributed to the smooth functioning of the new operational framework.[9]

The factors that prompted this transformation can be grouped in two categories: those linked to the changes in the economic and financial framework following Spanish entry into the EU; and those associated with the changes in the Banco de España balance-sheet, reflected in a change in sign of the banking system's liquidity dependence position in relation to that offered by the central bank.

The two groups of factors are not independent, moreover, of a clear attitude on the part of the Banco de España to give priority to market mechanisms as a selection criterion for the operational framework. This attitude has progressively infused the decisions that the Banco de España has taken in this area: the reduction of the RRs, the elimination of mechanisms for subsidised financing to credit institutions, the formulation of open market operations and, lastly, the decision to minimise operations implying bilateral relations between the Banco de España and its counterparties.

1.2.1 Changes in the economic and financial framework

Various changes in the Spanish economy's economic and financial framework since the mid-eighties are at the root of the modifications to the Banco de España monetary implementation framework and, in particular, of the advance in operational procedures to facilitate the close control of short-term interest rates.[10]

First, regard should be had to the implications for the monetary policy transmission channels arising from the modernisation of the Spanish financial system. The period prior to Spanish EU entry was marked by a deep-seated segmentation of Spanish money and financial markets, a stringent regulation of interest rates and limited external openness. Against this background, changes in Banco de España intervention rates were internalised in the markets for interbank funds, with scant propagation to the other markets. This situation was compatible with the pursuit of a monetary policy geared to the strict control of bank reserves via which it was sought to attain the monetary policy objectives, defined in terms of the growth of the money stock, and which, necessarily, entailed high volatility in the Banco de España intervention rate (see Chart 4). Further to Spanish EU accession and against a general backdrop of global liberalisation and deregulation, there was growing integration among the various Spanish money and financial markets, heightened competition and greater prominence for the role of the exchange rate of the peseta as a decisive aspect of the definition of economic policy in general, and of monetary policy in particular.[11]

The combination of all these factors favoured the propagation of the Banco de España's monetary impulses to the various markets, and it strengthened some of the transmission channels that had been scarcely operative in the preceding stage, in particular the exchange rate channel. The change in circumstances advised paying growing attention to the orderly course of interest rates. In this connection it was considered necessary for the Banco de España to use short-term interest rates as an

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government securities to be set up, which entities could use in their liquidity procurement operations. For greater details of the reform of the reserve requirement, see Banco de España (1990).

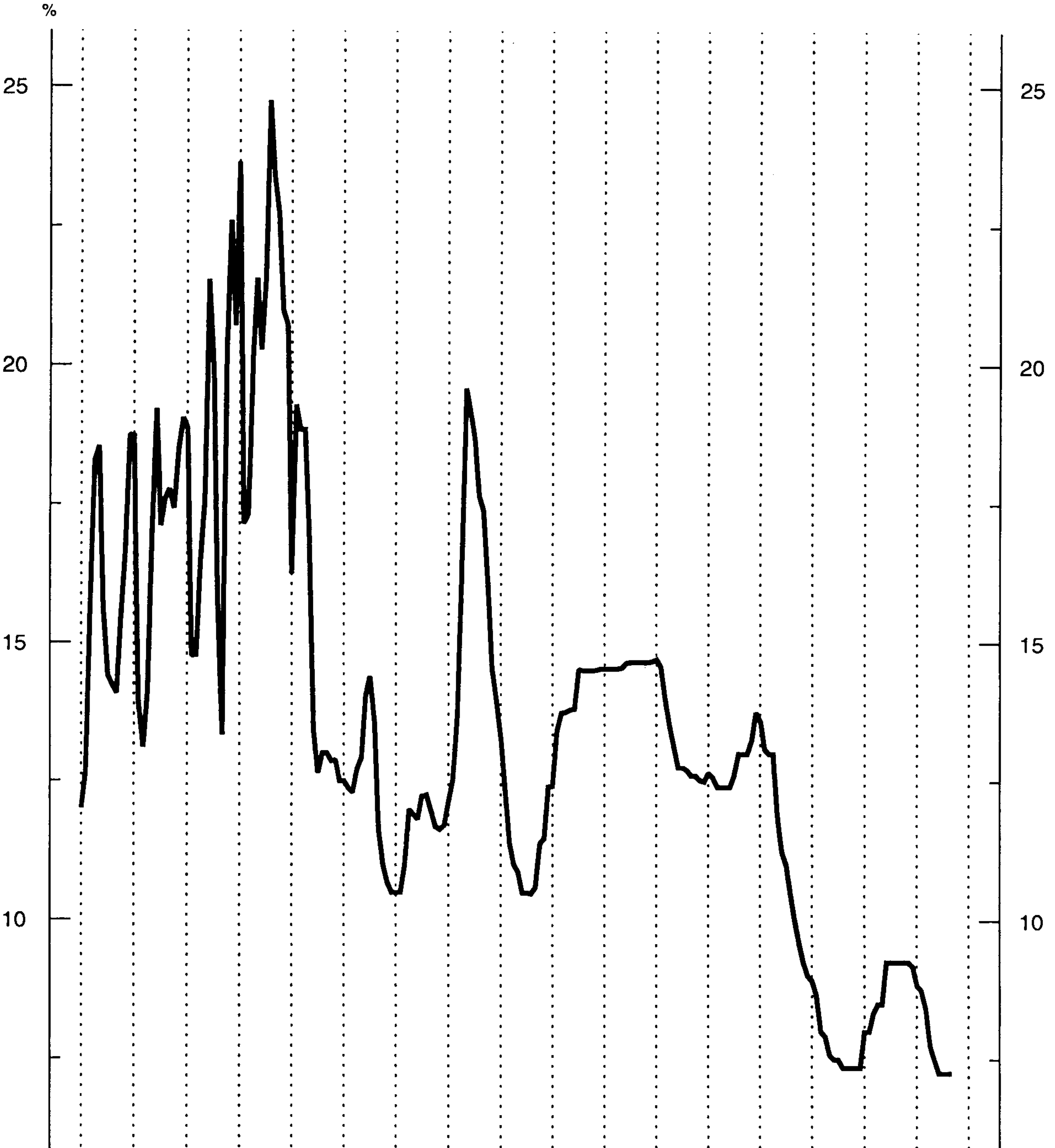
[9] On the one hand, it allows entities to have a securities portfolio with which to resort to the Banco de España in search of financing. On the other, the Book-Entry Office provided, along with the Money Market Communication Service, the technical infrastructure needed for the settlement of repos with government securities and CEBES.

[10] Some of these aspects are addressed in greater detail in Escrivá and Malo de Molina (1991) and in Ayuso and Escrivá (1996).

[11] On the implications of the financial integration and internationalization of the Spanish economy, see Alejano, A. and J.M. Peñalosa (1995).

instrumental variable and to develop the procedures required for fine-tuning them. The peseta's entry into the ERM in June 1989, and the assuming of the related exchange rate commitments, reinforced the role that interest-rate stability had to play in monetary policy implementation in Spain. And this despite the fact that, for a relatively extensive period, to end-1994, intermediate targets in terms of the growth of the money stock continued to be formulated.

Chart 4
Banco de España intervention rate
Monthly average of daily data



Note: Marginal interest rates of daily auctions of monetary regulation loans were used until April 1990. Since May 1990, the interest rate for the ten-day auction of Banco de España certificates has been used.

The need to ensure the proper working of the monetary policy strategy currently pursued by the Banco de España – which, since 1995, involves setting a direct target in terms of the inflation rate – bolsters the positive effect on the monetary policy transmission mechanism of the use of interest rates as an instrumental variable. Justifying the latter decision are the role of the exchange rate in this strategy and the reinforcement of some of the aspects relating to the determination of bank lending and borrowing rates and, in general, to the importance played by expectations in determining interest rates in the various markets.

Regarding the first aspect, the stability of the exchange rate of the peseta is considered an important factor for attaining price stability. As regards the second point, there has recently been a perceptible increase in the intensity and speed with which monetary impulses are transmitted to the various financial markets. It has been proved that in determining the interest rates on their credit operations, institutions, in the long term, completely adjust to movements in interbank overnight interest rates and that, in the process of adjustment, expected future interest rates acquire great relevance. The speed of adjustment is far greater in the case of floating rate loans, which leads to an acceleration in the transmission mechanism since the importance of this type of financing is continuously rising (see, for instance, Sáez, F. (1996)).

1.2.2 Changes in the Banco de España balance sheet and characteristics of the autonomous factors of liquidity generation

The present configuration of the implementation framework – in particular, the maintenance of a low reserve ratio – is also supported by the change in the Banco de España balance sheet and by the financing structure of entities. This change has been manifest in a most substantial increase in the banking system's liquidity requirements and in the consolidation of a sizable net debtor position vis-à-vis the Banco de España. Nonetheless, this increase in the debtor position has highlighted some of the difficulties the current implementation system poses, which are discussed below.

This configuration is a relatively novel one; historically the strongly expansionary nature of the autonomous factors of liquidity generation, and of the public sector in particular, has been a constant in the determination of the Banco de España's intervention requirements and it has meant that only through imposing a high reserve requirement would entities ultimately depend on the liquidity offered by the Banco de España.

To illustrate this aspect a relatively extensive time perspective should be adopted for analysis, and the asset and liability captions of the Banco de España should be grouped in such a way that the system's liquidity requirements may be explained by its two main sources: the first, resulting from the combined effect of the autonomous factors of liquidity generation, and reflecting general monetary conditions; and the second, consisting of the level of RRs.[12]

This decomposition, which is depicted in Chart 5, enables a link to be made between the heavy increase in reserve ratios, as from 1983, and the need of the Banco de España to face up to a situation in which the overall effect of the autonomous factors of liquidity generation, driven by the highly expansionary nature of the public sector, led to a heavy surplus position of liquidity in the banking system and made monetary implementation enormously complicated. As can be seen in the chart, this was reflected in the assumption by the Banco de España of a debtor position vis-à-vis the banking system.

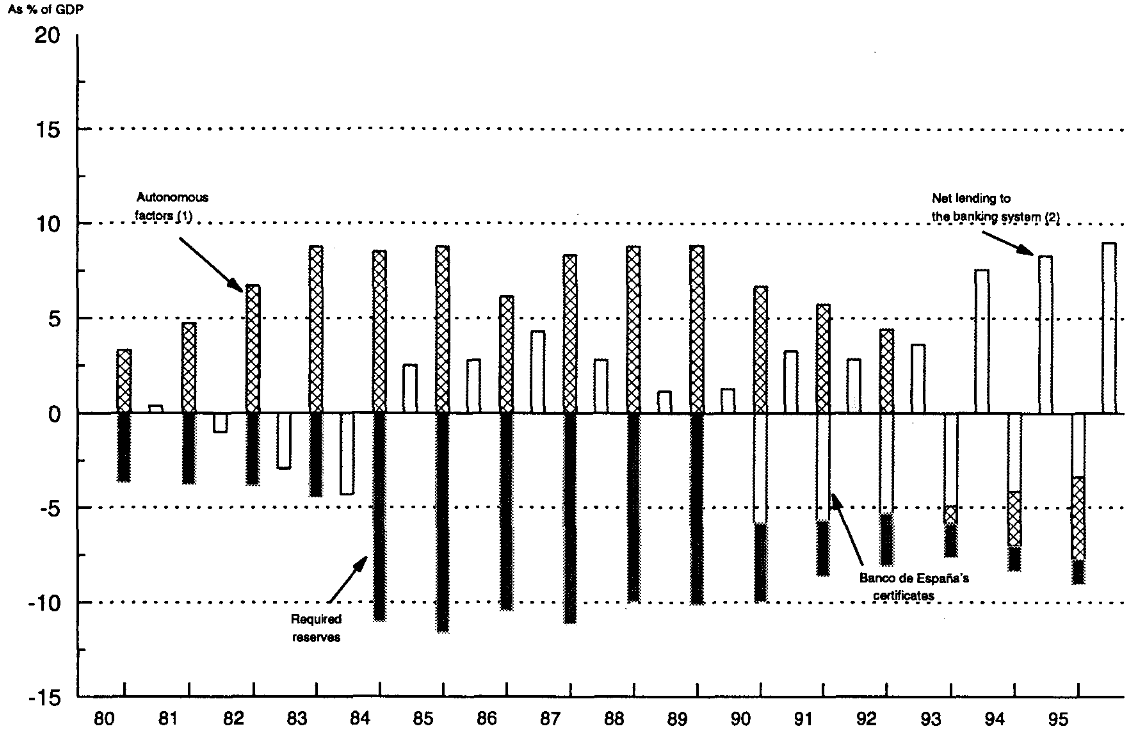
Following the heavy rise in the reserve requirement after 1983, the Banco de España managed to reverse the sign of the banking system's liquidity dependence in a setting in which the autonomous factors of liquidity generation continued to be highly expansionary. Against this

[12] Net credit from the central bank to the banking system (*NCBS*) results from the following identity: $NCBS = BN - FA - CPS + ONL + RR$, where BN = banknotes; FA = foreign assets; CPS = net credit to the public sector; ONL = other net liabilities; and RR = bank reserves and stock of CEBES.

Chart 5

Determinants of the Banco de España's net lending position to the banking system

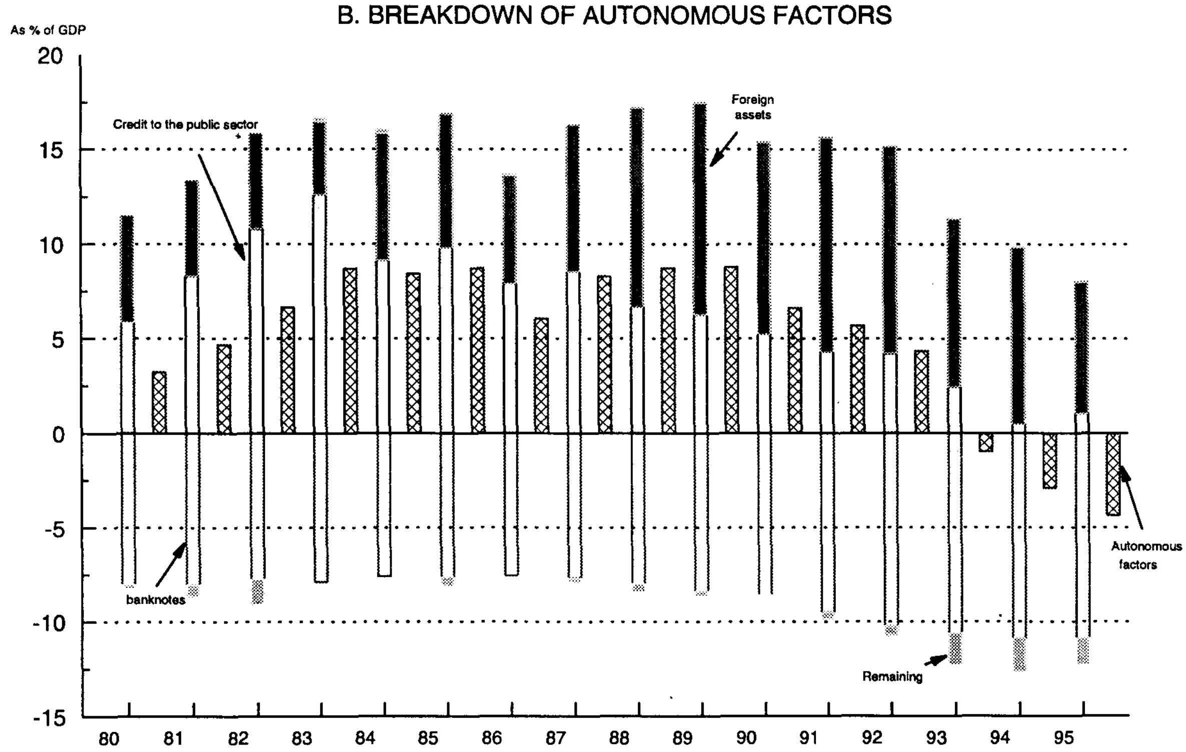
A. NET LENDING POSITION



(1) Autonomous factors= banknotes - net foreign assets -net credit to the public sector + other net liabilities

(2) Net lending= required reserves + atonomous factors.

B. BREAKDOWN OF AUTONOMOUS FACTORS



background, compliance with the reserve requirement was increasing the demand for funds for its coverage and was reversing the sign of the system's net liquidity requirements.[13]

This combination of factors differs radically from that prevailing since 1992. Since that year, the demand for financing by entities has increased enormously, reaching an amount equivalent to 10% of GDP at end-1995. The increase is of a genuine nature: it reflects the widening of entities' deficit liquidity position in the face of the reduction of the expansionary nature of the autonomous factors, which has not been offset by the lesser requirements derived from the reduction of RRs and the partial redemption of CEBES.

Further, the lower part of Chart 5 depicts changes in the various liquidity generating factors during the period under consideration. This allows the reasons for the change in the sign of the entities' liquidity position after 1992 to be specified.

As reflected in the foregoing chart, the expansionary character of the external sector lessened as from late 1992 as a result of the interventions by the Banco de España in defence of the exchange rate of the peseta during the ERM crisis. In addition, as from 1993, the step taken to comply with article 104A of the Treaty of Maastricht – which came into force in January 1994 and prohibits the monetary financing of the Treasury – imposed a permanent reduction in the net credit extended by the Banco de España to the public sector. The break with the expansionary nature of both factors until that point made it impossible to offset, as had been done in previous periods, the contractionary effect of the expansion of the demand for cash by the public, which accounted for somewhat over 10.7% of GDP at end-1995.

These changes are summarised in Table 1. It reflects the contribution of the various factors to the change in the dependence of credit institutions on Banco de España financing in the period 1990-95.

Table 1

Determinants of the change in financing extended to credit institutions by the Banco de España

1990-95, as a percentage of GDP

1.	Reduction in foreign reserves	3.2
2.	Reduction in net debtor position of General Government	4.6
3.	Increase in bank notes	2.3
4.	Reduction in bank reserves	-3.1
5.	Reduction in CEBES	-1.6
6.	Other items	1.2
Net liquidity requirements (1 to 6) = Financing to credit institutions		6.6

The combination of these elements has meant that the Banco de España has had to face up to growing demand for liquidity by entities. Also, on certain occasions over the past few years, tensions have consequently arisen in money markets, caused by the shortage of suitable instruments in entities' portfolios to pledge against the liquidity supplied by the Banco de España.

Along with the changes recorded in the Banco de España balance sheet, it is important to stress the high volatility of the autonomous factors of liquidity generation in the Spanish case. This characteristic has been integral to the functioning of the monetary policy implemented by the Banco de España and has conditioned certain aspects of its operative procedures. In particular, a greater volatility of the autonomous factors may entail greater difficulties in predicting liquidity shocks and, ultimately, entities' actual liquidity requirements. That may then bias monetary implementation towards a more intensive use of fine-tuning operations. Table 2 presents an international comparison

[13] A more detailed analysis of the autonomous factors of liquidity in the period prior to the reform of the reserve requirement can be found in Sanz, B. and M. Val (1993).

of the volatility of overnight interest rates and of the autonomous factors of liquidity generation, measured as the standard deviation of daily variations in relation to GDP. As the table shows, Spain is among the countries with the highest volatility, a feature it shares with other countries in which the public sector is also the highest-volatility autonomous factor (see, in this connection, Escrivá and Fagan (1995)). Furthermore, there is not an automatic link between changes in the autonomous factors and the behaviour of interest rates; on the contrary, as it is explained below and in a more formal fashion in the annex, a number of institutional factors intervene in the relation between these two variables.

Table 2

International comparison between interest rate volatility and liquidity shocks volatility

Countries	Overnight rate volatility[1]	Liquidity shocks volatility[2]
Austria	0.05	0.01
Belgium	0.10	0.09
Denmark	0.47	0.62
Finland	0.63	0.18
France	0.07	0.18
Germany	0.25	0.09
Greece	0.72	0.23
Ireland	0.31	0.20
Italy	0.27	0.39
Netherlands	0.13	0.31
Portugal	0.31	0.51
Spain	0.16	0.38
Sweden	0.03	0.38
United Kingdom	0.54	0.11

[1] Daily standard deviation of overnight market rates from official rates (December 1993 - December 1994). [2] Daily standard deviation of changes in autonomous items as a percentage of GDP (December 1993 - December 1994).

Source: Escrivá and Fagan (1995).

Chart 6 presents, for the Spanish case, the contribution of the various autonomous factors to total volatility over the last ten years, drawing on a variance decomposition of the daily changes in these factors.[14] As can be seen in this chart, the public sector, the most volatile autonomous component, has shown an increasingly irregular behaviour during the period under analysis. This has come about despite the institutional changes made throughout this period, which have tended first to reduce and next to prohibit the monetary financing of the budget deficit. This result is consistent with a highly active management of the Treasury's current account at the Banco de España, and with its use as an alternative financing instrument in the event of exceptional circumstances on the securities markets. The absence of a ceiling on movements in this account (which is the practice in some other European countries) may be contributing to this greater volatility. By contrast, the changes recently made to government debt tender arrangements, with the announcement and undertaking to meet an

[14] To illustrate the variance decomposition approach, consider the following definition of autonomous factors:

$AF = BN - FA - CPS + ONL$, where BN is banknotes; FA = net foreign assets; CPS = net credit to the public sector; and ONL = other net liabilities.

Multiplying across by AF and taking expectations yields:

$\mathrm{VAR}(AF) = \mathrm{Cov}(AF, BN) - \mathrm{Cov}(AF, FA) - \mathrm{Cov}(AF, CPS) + \mathrm{Cov}(AF, ONL)$.

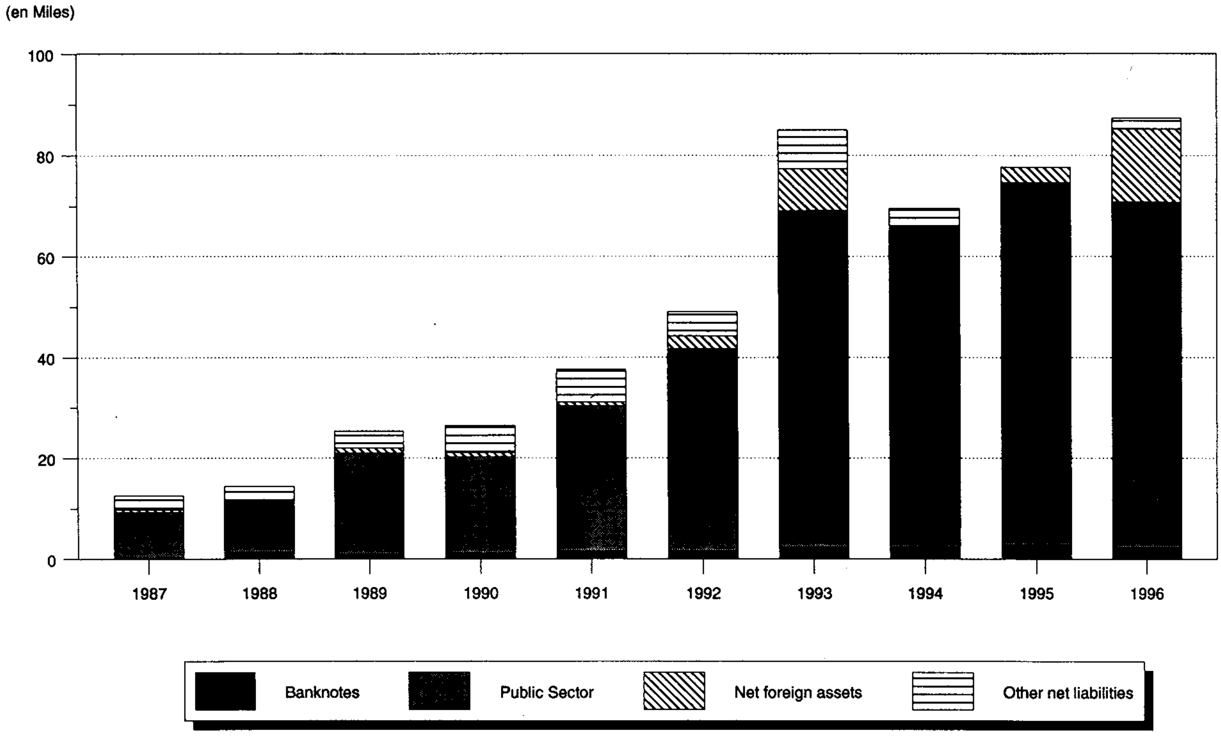
The covariance terms on the right-hand side of this equation show the contribution of each of the elements to the total variance of AF. For example, expanding the term $\mathrm{Cov}(AF, BN)$ yields:

$\mathrm{Cov}(AF, BN) = \mathrm{VAR}(BN) - \mathrm{Cov}(BN, FA) - \mathrm{Cov}(BN, CPS) + \mathrm{Cov}(BN, ONL)$.

Thus, the contribution of banknotes (BN) to the total variance is the sum of its variance plus its covariances with the other terms.

average issuance target, may end up having the opposite effect. The external sector, for its part, has contributed to amplifying this irregular profile in the recent years of the sample, as a result of successive ERM crises.

Chart 6
Contribution to total volatility in autonomous factors



2. Assessment of the functioning of the operational framework

The design of the Banco de España monetary policy implementation model is supported by two pillars. The first is the priority given to market mechanisms. The second is the selection of a set of suitable instruments to exert tight control on the course of short-term interest rates in the interbank deposit market. Assessment of the effectiveness of this operational framework should thus be made in the light of these two considerations.

2.1 Development of money markets

The Banco de España's monetary policy operational framework and the efficient functioning of money markets are closely interlinked. The framework, while aimed at fostering the development of secondary markets, also requires that a high degree of market efficiency be attained to adequately perform its tasks.

The aim to create disciplinary mechanisms for efficient liquidity management is reflected in a number of features of the framework:

- the exclusive reliance on open market operations for the Banco de España's intervention and, consequently, the lack of any lombard, deposit or refinancing facility;

- to cope with banks' end-of-day imbalances, the Banco de España, instead of providing liquidity via a marginal lending facility, usually re-opens the interbank market so that the banks with liquidity needs can find a lending counterpart;
- the lowering of the reserve ratio to 2%, while greatly reducing the implicit tax on banks entailed by this instrument, creates much tougher conditions for liquidity management so that banks must strive to optimise the level of the working balances they hold in their current accounts at the Banco de España to settle their interbank operations;
- all open market operations are conducted via repos so as to avoid the rigidities imposed on banks' portfolio management when collateral is pledged and blocked;
- in the case of fine-tuning operations, liquidity is provided to a small set of primary dealers, who perform the task of distributing it all across the money market; and
- the underlying assets (collateral) for repo operations are restricted to high quality paper traded in very liquid secondary markets.

An operational framework characterised by the above-mentioned features could lead to unwanted developments if the goal of promoting a deep and liquid secondary money markets were to fail. First, in the absence of such a market, difficulties encountered by banks in working off excess liquidity or covering reserve deficiencies, particularly towards the end of the interbank session, would be conducive to greater market instability. This is particularly so since there is a lack of facilities to deal with end-of-day imbalances. Second, if the interbank market were relatively narrow and some institutions were to enjoy a dominant position, certain banks, normally the smallest ones, would have worse conditions to enter and operate in the market. In this situation, the lack of automatic refinancing instruments provided by the central bank would be a serious shortcoming for these institutions. Third, if the market were not sufficiently deep, the fast and even distribution of liquidity across the market by primary dealers might encounter difficulties.

In our opinion, experience over the last few years shows that the trade-off between the potential benefits and risks of the Banco de España's operational framework is favourable on balance. Various pieces of evidence are provided below to support this view.

Table 3
Features of interbank fund transfer systems in EU countries*

Countries	Ratios		
	Number of transactions (thousands)	**Depth - transacted value (ECUm)**	**Breadth - average value (ECUm)**
Austria	5.4	2.8	3.2
Denmark	2.8	26.0	74.9
Finland	1.3	12.4	118.4
France	3.7	15.0	3.7
Germany	9.7	50.5	3.0
Ireland	3.6	24.4	152.5
Italy	6.6	26.8	4.7
Netherlands	8.7	32.1	13.3
Spain	6.5	64.0	24.2
Sweden	0.5	27.4	326.5
United Kingdom	13.7	38.7	3.3

* The systems in place in Belgium, Greece, Luxembourg and Portugal jointly process large-value payments and retail transactions. Consequently, they are excluded from this table. Values deflated by GDP; 1994 figures.

In the international sphere, comparison of measures of the depth and liquidity of securities-settlement and fund-transfer systems (see Tables 3 and 4) highlights Spain as one of the countries with the largest number of recorded transactions and the depth of the related systems – measured as the value of transactions in relation to GDP – is also greatest. In terms of breadth – measured by the average value of transactions – Spain would occupy a less differentiated position compared with the rest of the countries.

Table 4
Features of securities settlement systems in EU countries*

Countries	Ratios		
	Number of transactions (thousands)	**Depth - transacted value (ECUm)**	**Breadth - average value (ECUm)**
Austria	0.8	0.8	5.7
Belgium	5.7	8.8	8.0
Denmark	31.7	18.9	4.8
Finland	17.7	4.1	2.8
France	13.6	364.0	23.9
Germany	14.6	2.95	0.1
Ireland	0.7	2.2	77.5
Italy	16.5	7.6	0.5
Netherlands	0.0	0.11	65.7
Portugal	7.8	2.29	3.8
Spain	27.5	44.9	4.0
Sweden	18.4	30.8	10.1
United Kingdom	6.2	13.9	2.6

* Transactions carried out; trends in EU countries. Values deflated by GDP.

Source: Own data based on EMI figures (see EMI 1996a).

Table 5
Efficiency measures of the Spanish money and public debt markets

Markets and efficiency measures	1987-91	1992-96
Interbank money market[1]		
a) Overnight market		
Liquidity (%)	82.5	241.9
Depth (%)	8.2	14.4
Breadth (bn of pesetas)	1.18	3.25
b) Remaining maturities		
Liquidity (%)	14.9	34.9
Depth (%)	1.5	1.9
Breadth (bn of pesetas)	0.78	2.23
Public debt market[2]		
Liquidity (%)	12.4	54.9
Depth (%)	3.2	23.0
Breadth (bn of pesetas)	0.07	0.66

[1] Liquidity measures are calculated as the ratio of turnover to the reserve requirement plus the outstanding amount of CEBES. Turnover takes into account both overnight deposits and repos among market members. Depth is calculated as the ratio of turnover in billions of pesetas to GDP and breadth is turnover per operation. [2] Measures of depth and breadth are calculated as described in footnote 1, with liquidity calculated as the ratio of turnover to the outstanding amount of debt and turnover including outright spot purchases and repos with non-market members.

In the domestic sphere, the development of the overnight interbank market has, in the 1990s, been most noteworthy in showing that some of the characteristics of the operational framework, described above, have fostered the use of this market as the principal alternative to Banco de España financing. In Table 5, various measures of efficiency in the overnight market are shown. Furthermore, the implications of the operational framework have extended beyond the interbank money markets: the public debt market has also grown most forcefully since the constitution of the SACDE and the use of public paper as collateral for repo operations (see, again, Table 5). The efficiency of this market, approximated by various measures of liquidity, depth and breadth, has continuously increased.

2.2 Steering interest rates

Over recent years the Banco de España has progressively increased its capacity for influencing short-term interest rates and affecting agents' expectations about the future course of interest rates. From this standpoint, the operational framework has proven sufficient in attaining its objectives.

For a more complete assessment of this function, it would be advisable to analyse specific features of the instruments available to the Banco de España to regulate monetary conditions, before and after the change in the operational framework. In this respect, an analysis starting in 1988 and ending in 1996 may offer a suitable perspective. Throughout this period, however, significant changes ensued which are worth bearing in mind in the analysis undertaken. For this reason, a division into sub-periods has been made which enables the differentiation between the two implementation regimes, as well as a distinction between different reserve ratios and identification of episodes of instability in the ERM to be isolated. The sub-periods selected are shown in Table 6.

Table 6

Sub-periods	**Reserve ratio (%)**	**Other distinguishing features**
1: 4/1/88-2/8/88	18.5	Inception of daily auction of monetary regulation loans
2: 3/8/88-2/2/89	16.5	"
3: 3/2/89-12/7/89	18	"
4: 13/7/89-22/3/90	19-17	"
5: 23/3/90-11/9/92	5	Introduction of CEBES in March 1990 and inception of ten-day repo tenders of CEBES and public debt
6: 14/9/92-3/11/93	4.5-3	ERM turbulences
7: 4/11/93-28/6/96	2	—

The basic information that will be used in this sub-section for relating the behaviour of interest rates to the procedures used by the Banco de España for steering them is given in Table 7. The contents of this table allow conclusions to be drawn with respect to the following questions. To what extent has the greater volatility experienced by the autonomous factors of liquidity generation throughout the period been internalised in the liquidity requirement forecasts made by banks and the Banco de España? If such internalisation is the case, what are the procedures whereby banks have met their unexpected liquidity requirements? And lastly, to what extent has the reduction in the reserve requirements entailed a significant lessening of the role played by this instrument in enabling banks to meet unexpected liquidity shocks?

Regarding the behaviour of short-term interest rates, the change in the operational framework in 1990 prompted a reduction in the volatility of overnight rates. This reduction was only interrupted in the 1992-93 period, when tensions were recorded in Spanish money markets, against the background of exchange rate tensions in the ERM. That said, the volatility of overnight rates has been systematically higher since 1990 if it is calculated in terms of the daily intervention rate. That might reflect the behaviour at the close of ten-day accounting period for bank reserves where, since the reduction of the reserve ratio, significant – though specific – fluctuations in interest rates in the interbank deposit market have been perceptible.

This diminishing trend in interest rate volatility has come about despite the increased volatility of the autonomous factors of liquidity generation (as seen in the previous section). This may be indicative of a greater capacity of counterparties and/or the Banco de España to foresee liquidity requirements despite such greater volatility, or, alternatively, of a greater degree of activism on the part of the Banco de España.

Table 7
Factors affecting volatility in money market interest rates

Periods	**Volatility in interest rates**		**Liquidity shocks volatility**		**Reserve requirements**			**Degree of activism**	
	vis-à-vis 10-day inter-vention (1)	vis-à-vis daily inter-vention (2)	defini-tion A (3)	defini-tion B (4)	potential shock: absorp-tion capacity of bank reserves (5)	% of liquidity shocks absorbed by RRs (6)	reserve require-ment level (in %) (7)	frequen-cy of interven-tion (8)	% of liquidity shocks absorbed by FTOs (9)
4/1/88-2/8/88	0.156	0.084	0.065	0.049	0.082	0.902	18.5	0.705	0.047
3/8/88-2/2/89	0.247	0.186	0.171	0.048	0.073	0.376	16.5	0.624	0.521
3/2/89-12/7/89	0.442	0.347	0.147	0.047	0.100	0.771	18.0	0.657	0.117
13/7/89-22/3/90	0.305	0.322	0.337	0.069	0.085	0.378	19.0-17.0	0.509	0.515
23/3/90-11/9/92	0.159	0.197	0.351	0.087	0.024	0.237	5.0	0.722	0.714
14/9/92-3/11/93	1.540	1.247	11.924	3.193	0.030	0.301	4.5-3.0	0.968	0.675
4/11/93-28/6/96	0.186	0.200	0.447	0.118	0.012	0.194	2.0	0.911	0.779

(1) Daily standard deviation of the difference between the overnight rate and the ten-day intervention rate.
(2) Daily standard deviation of the difference between the overnight rate and the rate of fortnightly repo operations.
(3) Daily standard deviation of fine-tuning operations (daily intervention).
(4) Daily standard deviation of the difference between the actual magnitude of autonomous factors and the forecasts made by the Banco de España at the beginning of each maintenance period for the average level over this period.
(5) Reserve requirements as a percentage of the total balance sheet eligible for averaging multiplied by the length of the maintenance period (in days).
(6) Average percent of liquidity shocks absorbed by the reserve requirement, according to the decomposition of variance of total volatility in autonomous factors as shown in Chart 7.
(7) Level of reserve requirement in each of the periods considered.
(8) Ratio between the number of days of fine-tuning intervention and the number of working days.
(9) Average percentage of liquidity shocks absorbed by fine-tuning operations, according to the decomposition of variance of total volatility in autonomous factors as shown in Chart 7.

As to the capacity of banks and the Banco de España to anticipate liquidity requirements, the information in Table 7 shows the absence of significant progress following the change in the operational framework: the increase in the volatility of the autonomous factors has been accompanied by a sustained increase in unexpected liquidity shocks, interrupted only in the last two years of the sample. The course of this variable has been approximated by two alternative measures. The first, in column 3, has been obtained drawing on the daily intervention by the Banco de España.[15] The second,

[15] This variable could be a good proxy for unexpected liquidity shocks if banks confront expected shocks via the financing they obtain from regular operations. However, against a background of expectations of a slowdown, this measure could give misleading information of unexpected shocks.

in column 4, has been constructed on the basis of the deviations between the actual scale of the liquidity derived from the autonomous factors and the estimates made by the Banco de España at the start of each reserve requirement coverage period (the reference period for liquidity management both for the central bank and its counterparties). As both measures show, the scale of the unexpected liquidity shocks was extraordinary in 1992-93, especially in the latter year against the backdrop of the previously mentioned exchange rate tensions.

The lesser volatility of interest rates has arisen in a setting in which the capacity to absorb unexpected liquidity shocks via the reserve requirement has progressively been reduced in step with the lowering of the reserve requirement level. The course of this variable is approximated by two alternative measures which are detailed in columns 5 and 6 of Table 7. The first gives an idea of the liquidity buffer banks have during the reserve requirement coverage period to face up to unexpected liquidity shocks and, from this point of view, is of a potential nature. The second represents the part of liquidity shocks absorbed by the reserve requirements, according to the variance decomposition of total volatility in autonomous factors, which is depicted in Chart 7.[16]

An assessment of the extent to which a level of 2% suffices to provide a liquidity buffer ensuring the stabilising function of the reserve requirement is conditional upon the estimated level of the working balances (the minimum volume of funds required for banks to meet transaction clearance and settlement needs). This level is always difficult to estimate. It ultimately depends on the type of business in which banks engage, on their operational efficiency or on structural aspects inherent in the characteristics of the financial system in which they operate. A relatively straightforward estimate of this variable for the Spanish case indicates that it may, for the banking system as a whole, stand at a level close to 1.5% of eligible liabilities. Nonetheless, a ratio of this type may be perfectly compatible with the existence of banks for which a reserve requirement level of 2% is insufficient to provide a liquidity buffer which is adequate for the clearance and settlement of their transactions. This may condition the optimal fulfilment of the reserve requirement stabilising function and may be one of the determinants of the prominent presence of the Banco de España in the money markets.

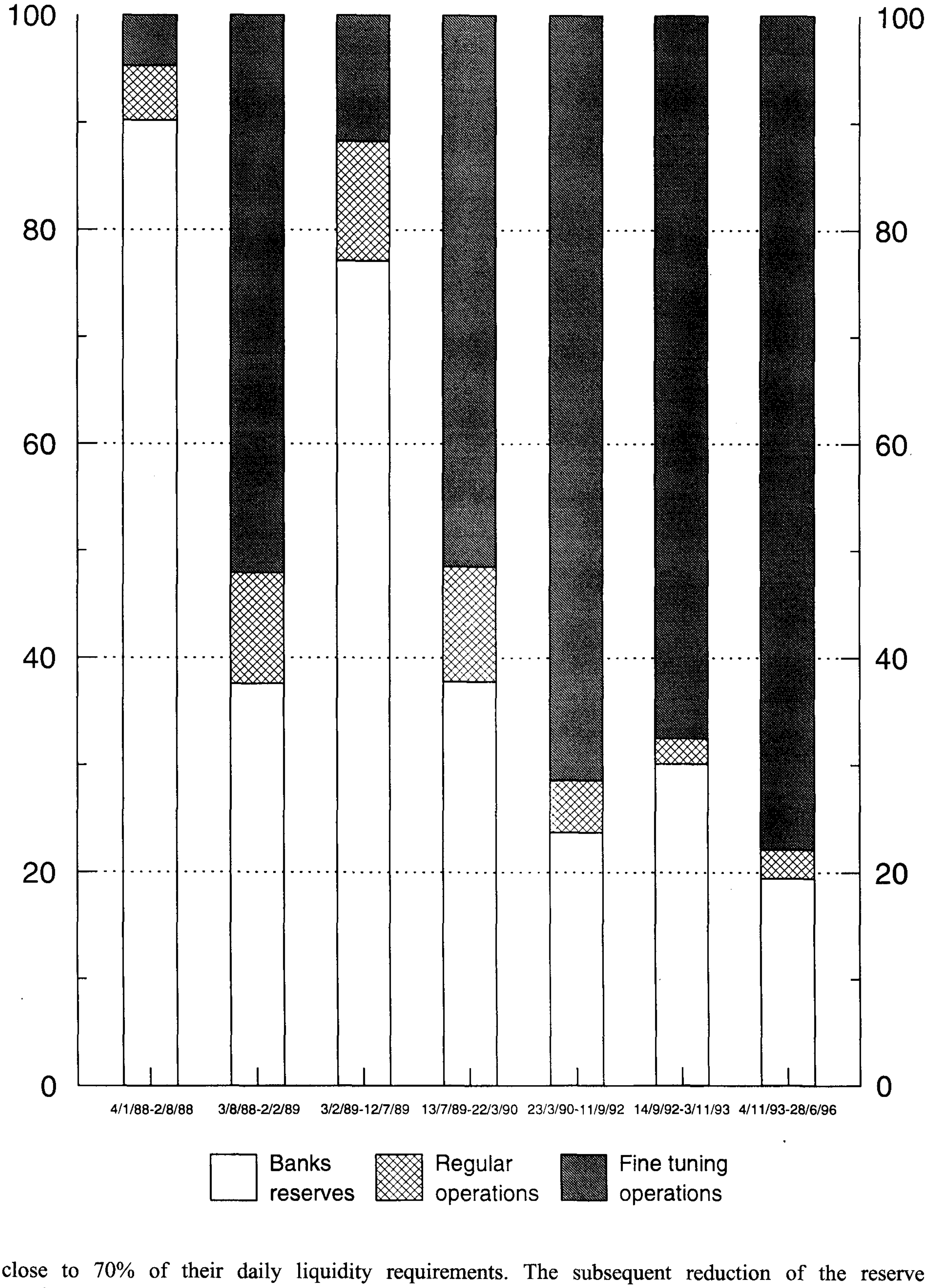
Against this background, the increasingly frequent use of daily interventions involving ever greater amounts is the most important stabilising element employed by the Banco de España to reduce interest rate volatility. Columns 8 and 9 of Table 7 offers a measure of the importance fine-tuning operations have acquired in the period under analysis. Frequency of intervention – calculated as the relationship between the number of days of intervention and the number of working days – indicates a sustained increase in the Banco de España's presence in the money markets (over 90% as from 1993 and slightly higher in the years of exchange rate instability).

The importance of fine-tuning operations is also visible from the analysis of the relative significance of the various instruments available to the Banco de España and its counterparties to face daily liquidity shocks. To this end, the decomposition of the variance of daily movements in the autonomous factors of liquidity generation is used again. As Chart 7 shows, the change in the operational framework entailed an uninterrupted increase in the significance of daily interventions as an instrument for tackling daily liquidity shocks. This increase came about progressively as the portion of shocks absorbed by the reserve requirement diminished. Regular operations, aimed at providing the portion of liquidity associated with the habitual refinancing mechanisms, have moved on a constant line.

The information in this chart thus summarises the implementation changes that have arisen as a result of the change in the operational framework: the obligation to hold a relatively high volume of reserves in the late 80s provided an extensive liquidity buffer that enabled banks to cover

[16] The variance decomposition underlying Chart 7 has been carried out using the same technique as explained in footnote 13. The variance of daily movements in autonomous factors is decomposed by the relative contributions of the three monetary policy instruments used by the Banco de España; note that $AF = RR - FT - RO$, where AF = autonomous factors; RR = reserve requirement; FT = fine-tuning operations; and RO = regular operations. The contributions are presented in percentage of the total variance.

Chart 7
Contribution of monetary instruments to total volatility in autonomous factors
As a percentage of total variance



close to 70% of their daily liquidity requirements. The subsequent reduction of the reserve requirement and the greater tendency towards open market operations prompted, by contrast, greater resort to the daily financing offered by the Banco de España, to the point where a proportion of over 70% of banks' daily liquidity requirements were covered by this means in the latter years of the period.

Econometric results presented in the annex broadly support the stylised facts presented in this section. These results show that expectations regarding future interest rates become a major determinant of the overnight rate. Conversely, the impact of shocks to autonomous factors, in spite of its size, is very minor, confirming the operation of the buffer-stock function of RRs and the stabilisation action of Banco de España's fine-tuning operations. Both instruments appear to be very important in performing this task. In this respect, econometric results hint that, in the absence of fine-tuning operations, the impact of shocks to autonomous factors on the overnight rate fluctuations would be three times as large as is the case at present; on the other hand, if the buffer-stock function of RRs were to be cancelled, contribution of autonomous factors to interest rate volatility would be six times as large as in the present situation. Therefore, the econometric analysis gives more importance to the stabilisation function of RRs than the evidence provided below based on variance decomposition of the changes in the autonomous factors and their correlations with the various monetary policy instruments. The results also show the loss of importance of the stabilisation function of RRs towards the end of the maintenance period and a parallel strengthening of the contribution of fine-tuning operations to stabilising interest rates.

2.3 Other implications of the operational framework

The operational framework described, which has been visibly effective in interest rate management, has not been fully free from occasional sources of friction. The causes of this have been the lack of collateral accepted in operations with the Banco de España and the difficulty, in certain circumstances, of emitting sufficiently differentiated signals about the optimal monetary policy stance. These problems arose with greater intensity during the period of exchange rate instability in 1992 and 1993, but they point to some of the aspects susceptible to improvement in the future. The reforms needed would, in any event, be consistent with those required to adapt the instruments within the framework of the preparatory work on the single monetary policy in EMU.

The insufficiency of collateral and the resulting tensions in money markets are relatively recent problems. They are closely linked to the increase in liquidity requirements that Spanish banks have undergone since late 1992 and to the relatively restrictive criterion applied by the Banco de España in the selection of collateral for intervention operations. The Banco de España's decision to give priority to the liquidity criterion has entailed the abandonment of securities pledging and the exclusive use of repos executed by the Central Book-Entry System as a procedure for securing the financing provided by the Banco de España. This has meant that the set of collateral instruments demanded by the Banco de España is made up of public securities and CEBES, with the outstanding balance of the latter being subject to a staggered redemption schedule due to end in the year 2000. As earlier indicated, the collateral available under this criterion has proven insufficient, particularly during bouts of selling pressure on the peseta, which have required intervention by the Banco de España in the foreign exchange markets and a decline in the external contribution to liquidity generation. The tensions caused by this lack of collateral have made it necessary to resort to ad-hoc procedures, such as currency swaps and special loans and, from time to time, to tolerate sizable deviations of the overnight interest rate on interbank deposits from the ten-day intervention rate. This may have prompted some confusion about what the degree of monetary tightness wanted by the Banco de España actually was.

Signalling difficulties also arise from other quarters. On the one hand, it may be argued that high degrees of activism by central banks may entail some loss of control over the timing of their market intervention, causing a risk that central banks become associated with any change in market interest rates. On the other, the Banco de España has opted to raise a single intervention rate to the category of official rate, namely the ten-day repurchase tender rate, which is no doubt consistent with the criterion of straightforwardness governing the configuration of the operational framework. But it implies a clear refusal to arrange more complex signalling systems, such as those in other countries, where the differentiated use of interest rates associated with different instruments allows a greater scaling of the signals emitted.

As earlier indicated, the work to adapt to the implementation of the single monetary policy requires the modification of these two aspects of the operational framework. First, private paper should be accepted as collateral; and further, a credit facility and a deposit facility should be introduced which, along with open market operations, will set up an interest-rate corridor and will broaden signalling potential, in line with the ECB guidelines (see EMI (1996b)).

3. Concluding remarks

1. The operational framework used by the Banco de España to implement monetary policy has evolved over the past ten years in line with general trends in other central banks. The increasing importance of open market operations and successive reductions in the reserve ratio are the main characteristics of this process.

2. Notwithstanding this consideration, monetary implementation in Spain has its own particularities, due partly to its conditioning factors.

   First, there is a group of environmental factors, which advised ensuring stability in money market interest rates. These are closely linked to the transformation in the monetary policy transmission mechanism and the increasing importance of the exchange rate as a key variable for economic policy decisions.

   Second, there is a set of factors relating to changes in the Banco de España balance sheet. Among these, the increase in the banking system's liquidity dependence in relation to the financing offered by the Banco de España allows monetary policy implementation to work with a low reserve ratio, thus making the enlargement function of RRs redundant. At the same time, the high volatility of the autonomous factors of liquidity generation – one of the highest at the EU level – implies that with lower reserve ratios, instability in money markets would have been high in the absence of a frequent intervention by the Banco de España.

   A third conditioning factor is the attitude on the part of the Banco de España to give priority to market mechanisms as a selection criterion for the operational framework.

3. The resulting model for monetary implementation, in which transparency and straightforwardness are the most relevant characteristics, has been successful in its main function: to exert tight control and to minimise the volatility of short-term interest rates. An increasing use of daily interventions has been the most important element employed by the Banco de España to achieve this goal.

   At the same time, the procedures used by the Banco de España have promoted, trough the introduction of disciplinary mechanisms, an efficient functioning of monetary markets. Equal treatment in terms of the access to finance provided by the central bank and an even distribution of liquidity across the market are both characteristics which show this development.

4. In the course of the last years and coinciding with specific episodes of high instability in money markets – normally caused by strains in the ERM – monetary implementation has faced occasional sources of friction. In this regard, two sort of difficulties have been faced by the Banco de España:

   On the one hand, against a background of increasing liquidity needs of credit institutions – aggravated by the restrictive stance of the external sector as a source of liquidity generation – the collateral accepted in operations with the Banco de España proved to be insufficient.

On the other, some aspects of the operational framework tended to complicate the signalling function of monetary implementation. High degrees of activism may, under specific circumstances, entail loss of control of intervention. Furthermore, although in agreement with an approach based on straightforwardness, using a single official rate for both modifying money market conditions and signalling the monetary policy stance reduces the room for manoeuvre of central banks for scaling signals emitted.

These problems point to some of the aspects susceptible to improvement in the future, in the process of adaptation to the single monetary policy in EMU.

Annex

The functioning of the Spanish market for bank reserves: a simplified model and some empirical evidence

The aim of this annex is to gain further insight into the functioning of the Spanish market for bank reserves. First, a model for the determination of the overnight rate incorporating key institutional features of the Spanish money market is built. Particular attention is paid to the modelling of the banks' demand for reserves under a system of required reserves. Second, empirical work is undertaken whereby some implications of the model are tested. The empirical analysis is designed so as to provide further evidence on the relative importance of the various determinants of the volatility of the overnight rate.

1. Modelling the Spanish market for bank reserves

Money market participants operate in an environment which is defined by the following elements:

a) There is a *reserve requirement system* which includes averaging provisions, whereby banks are obliged to hold at the central bank non-remunerated reserves (R) at an average level $\bar{R}$ over a maintenance period spanning from t=1,......,T. It is assumed that banks exactly meet the required level $\bar{R}$; i.e. there are neither excess reserves nor reserve deficiencies. This assumption seems reasonable for the Spanish case given that banks maintain an extremely low and fairly stable level of excess reserves and that non-fulfilment of required reserves is a very infrequent situation. Thus, $\bar{R} = \frac{1}{T}\sum_{t=1}^{T} R_t$. Reserve excesses or deficiencies cannot be carried over from one period to the next. Moreover, banks are not allowed to have overdrafts in their accounts with the Banco de España. It is also assumed that the level of required reserves is well above the working balances that banks would normally hold for settlement purposes in the absence of any system of reserve requirements and that the required average level is known in advance over the entire maintenance period.[17]

b) The Banco de España exclusively uses *open market operations* to steer money market rates. These operations can be of two types:

   i) *regular operations* (*RO*), conducted at fixed intervals and aimed at providing regular basic refinancing and conveying policy signals. The interval between regular operations is equal to the length of the maintenance for required reserves. The operations are carried out at the start of each maintenance period.

   ii) *fine-tuning operations* (*FT*), carried out whenever necessary to limit interest rate volatility.

[17] This assumption, which is indisputable when the end of the computation period for the eligible liabilities precedes the start of the maintenance period, appears reasonable for the Spanish case, where there is some overlapping between the two periods, because the banks' margin of error in estimating their eligible liabilities on average over the computation period is relatively low. However, this margin of error tends to fade as the maintenance period progresses.

c) AF is the sum of the *autonomous factors* impinging on the money market (i.e. net foreign assets plus net asset position vis-à-vis the government minus banknotes and minus other net liabilities). Thus, the Banco de España's balance-sheet identity can be written as:

$$AF = R + RO + FT \tag{1}$$

d) *Decision-making by the Banco de España's* on whether and how to intervene takes places in two steps, at two different frequencies:

i) *Step 1* (at the time of regular operations). At this frequency, the reserve market equation (1) boils down to:

$$RO = \overline{AF^e} + \overline{R} \tag{2}$$

which assumes that the regular open market operation (*RO*) undertaken at the start of the maintenance period covers the banks' need for reserves to meet the required level $(\overline{R})$ while offsetting the expected value of autonomous factors during the maintenance period $\overline{AF^e} = \frac{1}{T} E_t \sum_{t=1}^{T} AF_t$.

ii) *Step 2* (daily frequency). Between regular operations, there may be variations in the banks' demand for reserves or in reserve supply. Shifts in demand reflect mostly the banks' behaviour in meeting required reserves, changes in desired working balances or expectations on future interest rates over the maintenance period. The supply of reserves may be affected not only by shocks to the autonomous factors, but also by the fine-tuning operations which may be carried out at the discretion of the central bank. All these factors will be examined in greater detail below.

On the basis of equation (2), which implies that the regular provision of liquidity (*RO*) matches banks' average demand for reserves plus the expected autonomous factors, the daily Banco de España balance sheet over the reserve maintenance period (*t*=1,.....,*T*) can be rewritten as:

$$RD_t = AF_t^{ne} + FT_t \tag{3}$$

where *RD* is the deviation of daily reserve balances from the average required level $(RD_t = R_t - \overline{R})$ and AF_t^{ne} is the deviation of autonomous factors from their expected average level over the maintenance period ($AF_t^{ne} = AF_t - \overline{AF^e}$).

This second step will be the focus of the remainder of this section and of subsequent empirical analysis, which first specifies behavioral equations for the components of equation (3).

1.1 Behaviour of factors influencing the supply of and demand for reserves

The *supply of reserves* within the maintenance period reflects two factors: the behaviour of autonomous factors and fine-tuning operations carried out by the Banco de España. As regards *autonomous factors*, they can be assumed to be interest-rate-inelastic and just to follow a stochastic process. The behaviour of the Banco de España concerning *fine-tuning operations* can be modelled as follows:

$$FT_t = \beta(\grave{o}r_t - rr) \tag{4}$$

which represents a simple reaction function whereby the Banco de España injects (mops up) liquidity whenever the overnight rate (*or*) tends to rise (fall) relative to the central bank's target rate. Of course, it provides only of a simplified description of the behaviour of fine-tuning operations. The underlying assumption that the target for the overnight rate coincides with the rate set by the last regular repo operation (*rr*) should be seen only as a proxy of the actual targeting by Banco de España of the overnight rate. Rather than by a point target, this targeting is characterised by a tolerance band around the marginal rate set at the last ten-day period repo tender. However, the fact that this band is normally very narrow supports the simplified reaction function presented above. On the other hand, equation (4) assumes that the Banco de España reacts to offset interest rate movements regardless of the source of the shock. This properly characterises most of the Banco de España behaviour's concerning fine-tuning operations. However, on certain – though rather seldom – occasions the Banco de España does not accommodate certain shocks (for instance, specific episodes of increased demand for liquidity in the domestic money market resulting from severe exchange rate instability) and accepts relatively persistent deviations (for a few days) of the overnight rate from the official repo rate.

As regards the *demand for reserves,* it is swayed by banks' reserve management over the maintenance period, which, in turn, is fully conditioned by the existence of averaging provisions. The key feature of averaging provisions is that they allow banks to choose when, during the maintenance period, they prefer to meet the reserve requirement, subject to the constraint that their average level is equal to the required one. Every day, banks need to make a decision on what portion of the overall reserve requirements they intend to meet; i.e. on whether they want to hold reserves equal to, below or above the one required level. The banks' decision on the desired level of reserves will be made on the basis of a number of factors:

i) The *expected opportunity cost of holding reserves* on each particular day. Such opportunity cost is given by the difference between the current level of the overnight rate (or_t) and its expected level over the remaining part of the maintenance period

$$(E_t \overline{or} = E_t \frac{1}{T-t} \sum_{i=t+1}^{T} or_t).$$

Banks have an incentive to meet as much as possible of the requirement on those days of the maintenance period when the cost of financing such reserve holdings is lowest. If the current rate is above (below) the expected rate, banks will tend to hold reserves below (above) the average required level. The responsiveness of daily reserve balances to the spread between the current and expected rate ($or_t - E_t \overline{or}$) can be defined by a parameter (η) which measures the buffer-stock stabilising function of averaging provisions: the higher the value of the parameter, the larger the contribution of averaging provisions to stabilising interest rates. The value of this parameter, in turn, depends on certain technical features of the reserve requirement system (such as the length of the maintenance period and the level of working balances relative to required reserves), as well as on structural aspects of the banks' behaviour (degree of risk aversion; degree of uncertainty about the expected average level of overnight rates). These features are not explicitly modelled here.

ii) The *unfulfilled portion of the overall reserve requirement,* which will have to be met over the remainder of the maintenance period. It is bounded by the amount of reserves that a bank could be willing to hold (upper bound) and by the level of working balances that banks need to maintain (lower bound, normally determined by technical and institutional factors).

As a result of this factor, the relative importance of the different parameters in defining the banks' behaviour varies in a significant way during the course of the maintenance period. At the start, the constraint represented by the overall requirements is not very binding, and allows banks considerable discretion. Banks can thus respond to interest rate movements that are perceived as temporary by holding a higher or lower level of reserves; in so doing, they tend to absorb such interest rate shocks to a large extent. As the end of the maintenance period approaches, the constraints represented by the overall requirement and by previous decisions in fulfilling it become progressively more binding, leaving banks less leeway to absorb money market shocks. At the same time, the relevant time horizon over which interest rate expectations are assessed becomes shorter, reducing the time available for a future reversal of current interest rate movements. As a result, the banks' demand for reserves becomes less elastic. At the limit, on the last day of the maintenance period it is totally inelastic, as banks have no choice but to meet any unfulfilled portion of the overall requirement.

This constraint imposed on banks by a system of required reserves can be modelled as a stochastic seasonal pattern in the daily reserve balances. In response to the behaviour of current interest rates and to their expectations of future interest rates, banks engage in strategies which imply an accumulation of reserve positions either above or below the required average level. Even in a context of constant expectations on interest rates over the remainder of the maintenance period, there may be an incentive for banks to postpone fulfilling the reserve requirement to the end of the maintenance period due to the interest compounding on the tax associated with non-remunerated required reserves. As the maintenance period progresses, this accumulated position tends to become increasingly more binding for the management of reserves in the remaining days of the maintenance period. At the limit, on the last day of the maintenance period, the level of reserves will be fully pre-determined by the accumulated reserve position of the day before. In other words, the pace at which previous decisions during the maintenance period condition current reserve management tends to accelerate as the end of the maintenance period approaches. To model this pattern, let us first define the accumulated reserve position:

$$(AR_t = \sum_{h=1}^{t} R_h - t\overline{R}).$$

Note that $RD_t = R_t - \overline{R} = \Delta AR_t$. One component of the determination of RD over the maintenance period can be seen as a sort of error correction mechanism, the "error" to be corrected being AR_{t-1} (i.e. the accumulated reserve position lagged by one day) and the error correction parameter (α_s) increasing in value as the end of maintenance period approaches.

As the weight of the error-correction mechanism increases towards the end of the maintenance period, so the role of the expectational variables discussed above lose importance in the determination of reserve demand. This pattern can be modelled by means of time-varying parameters whose values depend on the position within the maintenance period (s), probably in a non-linear fashion. Thus:

$$\Delta AR_t = -\alpha_s AR_{t-1} - \eta_s\left(or_t - E_t\overline{or}\right) \tag{5}$$

where $\frac{\partial\alpha}{\partial s} > 0$; $\frac{\partial\eta}{\partial s} < 0$; $\alpha_T = 1$; and $\eta_T = 0$.

Expression (5) can be rewritten in order to insulate an expectational component regarding future interest rates as follows:

$$\Delta AR_t = -\alpha_s AR_{t-1} - \eta_s\left(or_t - rr\right) + \eta_s\left(E_t\overline{or} - rr\right). \tag{6}$$

1.2 Reduced-form solution

Substituting equations (4) and (6) into (3) and solving out for $\left(or_t - rr\right)$, we obtain:

$$(or_t - rr) = \varepsilon_s AF_t^{ne} + \pi_s AR_{t-1} + \rho_s\left(E_t\overline{or} - rr\right) \tag{7}$$

$$\text{where } \varepsilon_s = \frac{1}{(\eta_s + \beta)}; \; \pi_s = \frac{-\alpha_s}{(\eta_s + \beta)}; \text{ and } \rho_s = \frac{\eta_s}{(\eta_s + \beta)}.$$

Equation (7) is a reduced-form equation whereby the overnight rate is determined. Three variables account for the deviations of the overnight rate from the repo rate: the unexpected autonomous factors, the one-day-lagged accumulated reserve position, and, finally, expectations regarding future rates. The weight of these three variables in determining reserves demand varies over the maintenance period. The three variables can contribute to money market volatility and must be countered by the Banco de España if this volatility exceeds its desired level.

The central bank has at its disposal two devices to neutralise the impact of these factors on the overnight rate. These devices are the two structural parameters of the denominator of the reduced-form parameters of the model: the buffer-stock parameter of the demand for reserves (η); and the steering parameter of the fine-tuning operations (β). The higher the value of these parameters, the lower the impact of the "destabilising" factor on the overnight rate.

2. Estimate of the reduced-form equation for the overnight rate

2.1 Econometric analysis

Empirical work has been carried out to estimate a reduced-form of the overnight rate relative to the repo rate in line with equation (7). The estimated dynamic equation takes the form:

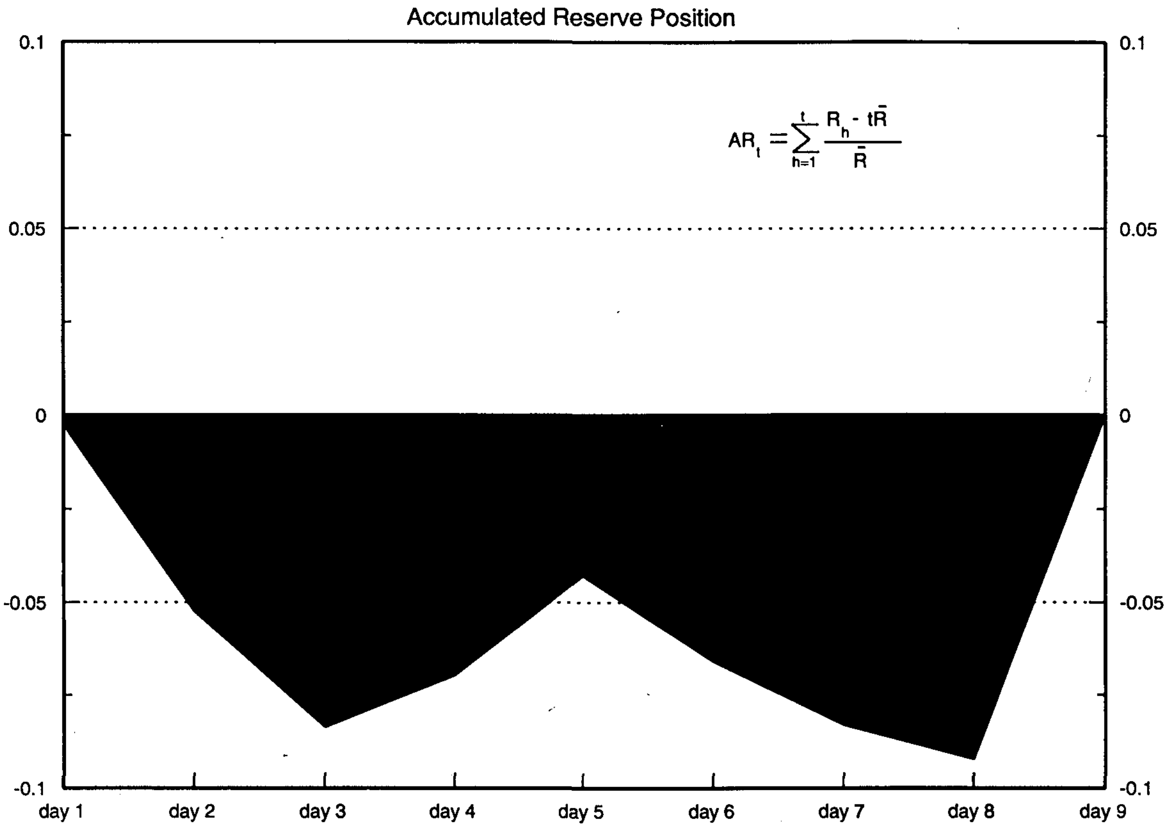
$$(or - rr)_n = \tau_0 + \left(\varepsilon_0 + \varepsilon_1\left(\frac{t}{T}\right) + \varepsilon_2\left(\frac{t}{T}\right)^2\right)AF_n^{ne} + \left(\pi_0 + \pi_1\left(\frac{t}{T}\right) + \pi_2\left(\frac{t}{T}\right)^2\right)AR_{n-1} + \left(\rho_0 + \rho_1\left(\frac{t}{T}\right) + \rho_2\left(\frac{t}{T}\right)^2\right)\left(E_n\overline{or_n} - rr_n\right) + \text{ lags}$$

of the left and right-hand side variables.

Compared to equation (7), this testable version of the model incorporates a constant term which chiefly captures deterministic components of the financial spread. Moreover, a dynamic relationship between the overnight rate and the explanatory variables is allowed by including – if statistically significant – one-lagged terms of both the dependent and the right-hand side variables. It should be noted that the left-hand side variable is not the overnight rate itself, but the difference between the overnight and the official repo rate. Therefore, the empirical results explain the deviations of the overnight rate from the repo rate, but do not contain any information on the determinants of the overall level of the repo rate.

This equation is estimated with daily data over a sample (n = 1,..., N) spanning from November 1993 to June 1996. $(or - rr)_n$ and AR_n are observable variables. As regards the latter, in Chart A1, the average time pattern of the lagged accumulated reserve position – as well as daily reserve balances relative to the average requirement – over the maintenance period in the entire sample is plotted. It is apparent from Chart A1 that the dominant time pattern of the accumulated reserve position is one of under-fulfilling over most the maintenance period and a rapid reversal of reserve deficit positions during the last days of the period. This may indicate the closeness of the required reserves to working balances. It could also show that delaying the payment of the implicit tax entailed by the reserve requirement system seems to be an important consideration in the banks' reserve management. The expectational variable regarding future overnight interest rates (E_n or_n) and the unanticipated component of autonomous factors (AF_n^{ne}) are non-observable. The former has been proxied by longer maturities – between 5 and 10 days – of money market rates. For the autonomous factors, two alternative approaches have been taken. Firstly, it has been assumed that the liquidity

Chart A1
Average time pattern of Bank's reserve position
over the maintenance period in the entire sample (November 1993 - January 1996)



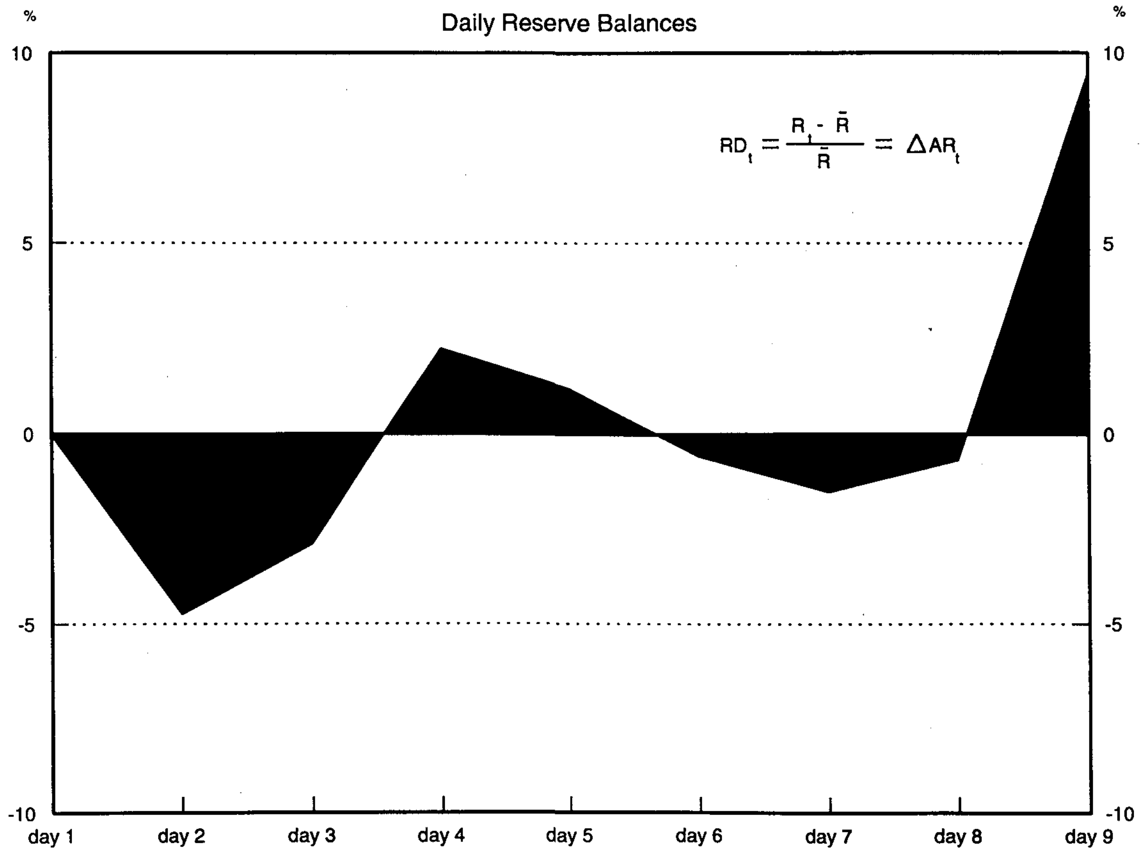


Table A1

Dynamic equation for the overnight rate

$$(or-rr)_n = \left(\varepsilon_0 + \varepsilon_1\left(\frac{t}{T}\right) + \varepsilon_2\left(\frac{t}{T}\right)^2\right) AF_n^{ne} + \left(\pi_1\left(\frac{t}{T}\right) + \pi_2\left(\frac{t}{T}\right)\right)^2 AR_{n-1} +$$

$$+\left(\rho_{00} + \rho_{01}\left(\frac{t}{T}\right) + \rho_{02}\left(\frac{t}{T}\right)^2\right)\left(E\overline{or} - rr\right)_n + \delta_0 (or-rr)_{n-1} +$$

$$+\left(\rho_{10} + \rho_{11}\left(\frac{t}{T}\right) + \rho_{12}\left(\frac{t}{T}\right)^2\right)\left(E\overline{or} - rr\right)_{n-1} + \varepsilon_n$$

Sample period: 4/11/93 - 28/6/96

$\varepsilon_0 =$ 0.027 (3.3)	$\rho_{00} =$ 0.48 (2.5)	$\rho_{10} =$ -0.83 (-13.7)
$\varepsilon_1 =$ 0.143 (3.5)	$\rho_{01} =$ 1.8 (2.9)	$\rho_{11} =$ 2.72 (7.3)
$\varepsilon_2 = -\varepsilon_1$	$\rho_{02} =$ -1.3 (-2.9)	$\rho_{12} = -\rho_{11}$
$\pi_1 =$ 0.15 (Fixed)	$\delta_0 =$ 0.74 (30.4)	
$\pi_2 =$ -0.30 (Fixed)		

$R^2 =$ 0.81	DW= 1.9	SSR= 4.26
$\sigma_\varepsilon =$ 0.08	F (11,644) = 398.7	

Variance decomposition of the overnight rate by its determinants

Absolute value of the variance of:

$(or-rr)$	$\bar{\varepsilon}AF^{ne}$	$\bar{\pi}AR$	$\bar{\rho}(Eor-rr)$	Residuals	Covariance
0.034	0.0013	0.003	0.024	0.016	-0.01

Relative contribution of variance of $(or-rr)$ (in percentages):

100	4	1	76	52	-33

Residuals

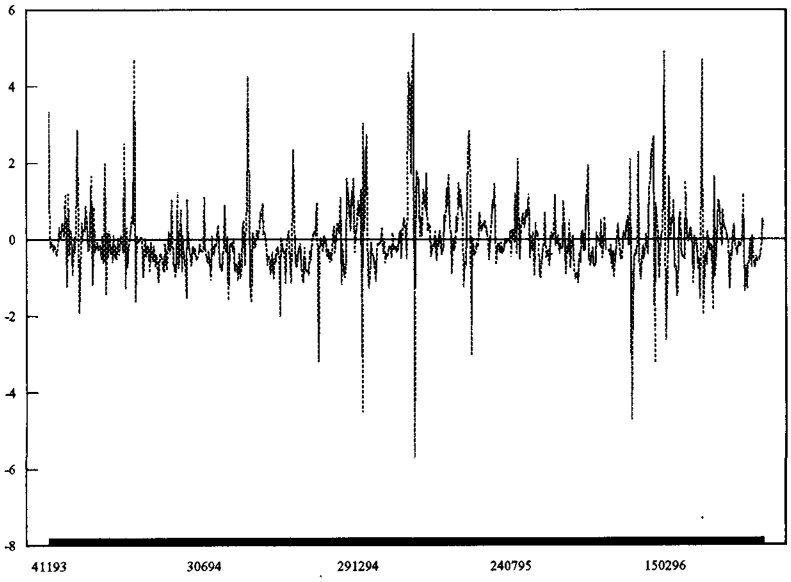
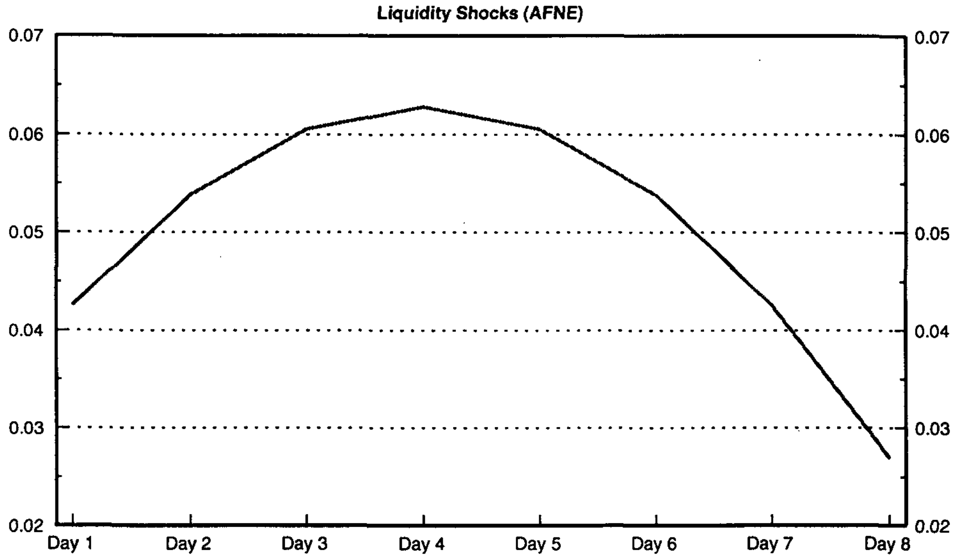
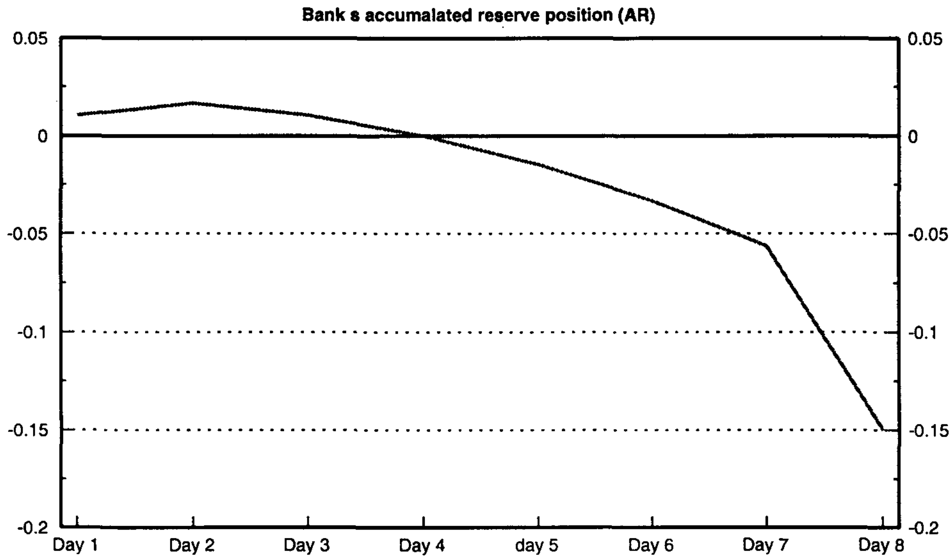


Chart A2

Time pattern over the maintenance period of the parameters of the variables accounting for the overnight rate fluctuations





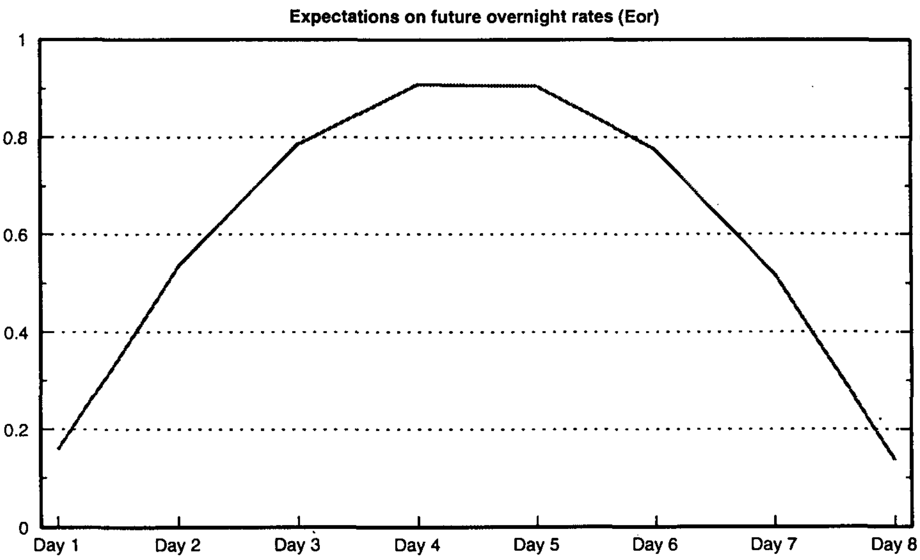


Table A2

Average parameters over the maintenance period		
Reduced-form parameters		
$\bar{\varepsilon} = 0.05$	$\bar{\pi} = -0.027$	$\bar{\rho} = 0.59$
Structural parameters		
$\alpha = 0.54$	$\beta = 8.1$	$\eta = 11.7$

Change in reduced-form parameters under two alternative scenarios			
		Zero degree of activism $(\beta = 0)$	Zero buffer-stock effect of RRs $(\eta = 0)$
$\bar{\varepsilon}$	=	0.085	0.123
$\bar{\pi}$	=	-0.045	-0.066
$\bar{\rho}$	=	1	1.44

provided by regular open market operations matches the observed average of the autonomous factors from this average level, a second estimate of the unanticipated component of the autonomous factors is obtained. It can be advanced that econometric results are not very sensitive to the alternative use of these two variables. The equation reported below includes the second of the two proxies for AF^{ne}, which yielded slightly better results.

The possible non-linear time-varying shape of the parameters is proxied by a second order polynomial in a variable (*t/T*) which measures the position within the reserve maintenance period. In this regard, the specification of the model allows for testing the extent to which this position is determining the value of the parameters. In the case where the only independent terms of the polynomial – those with a zero sub-index – are statistically significant, the hypothesis that variables influence the overnight rate according to a seasonal pattern associated with the reserve requirements maintenance period would be rejected. If the first-order terms are significant, then the parameters are varying over the maintenance period in a liner fashion. Finally, the significance of the second-order terms would be an indication of non-proportional changes in the value of the parameters over the maintenance period.

In Table A1, the econometric results are summarised. The table first provides the estimated parameters of the dynamic equation which gives a first indication of the relative weight of the various factors determining fluctuations in the overnight rate relative to the official repo rate. However, these parameters only provide a rough indication of the relative contribution of the explanatory variables since the actual variance of the latter differs substantially across variables. In this regard, Table A1 also includes – along with some statistics and a plot of the residuals of the model to check its properties – the variance decomposition of (*or-rr*) by the model determinants, which provides a more accurate quantification of the relative contribution of the various variables; given that, by construction, all the variables of the model are stationary, the computation of this variance decomposition is legitimate. Two other pieces of evidence regarding the econometric results are also provided. First, Chart A2 plots the estimated time pattern over the maintenance period of the three explanatory variables on average over the entire sample. Second, Table A2 presents the average reduced-form and parameters over the maintenance period. From the estimated parameters, it is possible to recoup the structural parameters of the model presented in the previous section. Once these paraments were obtained, two simple exercises were carried out. First, it was assumed that β=0; i.e. a scenario with no fine-tuning operations by the Banco de España (zero degree of activism), while the other two structural parameters were left unchanged and the average reduced-form parameters were recalculated. Second, this exercise was repeated assuming $\eta=0$, meaning that the buffer-stock function of RRs is cancelled. The results of this exercise are also provided in Table A2.

2.2 Conclusions from empirical results

On the basic of these empirical results, a number of conclusions can be drawn:

a) as a result of the existence of RRs with averaging provisions, expectations regarding future interest rates become a major determinant of the overnight rate;

b) the impact of autonomous factors is very minor, confirming the operation of the buffer-stock function of RRs and the stabilisation action of Banco de España's fine-tuning operations; obtained structural parameters suggest that both instruments are very important in performing this task. In this respect, econometric results hint that, in the absence of fine-tuning operations, the impact of shocks to autonomous factors on the overnight rate fluctuations would have been three times as large as is the case at present; on the other had, if the buffer-stock function of RRs were to be cancelled, contribution of autonomous factors on interest rate volatility would have been six times as large as the present situation; and

c) the impact of the lagged-accumulated reserve position is limited, although increasing as the maintenance period progresses. This shows the loss of importance of the stabilisation function of RRs towards the end of the maintenance period and is an indirect indication of a more active use of fine-tuning operations on those days.

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Money market operations in the United Kingdom

Creon Butler and Roger Clews[1]

Introduction

Two developments over the past few years have had a significant influence on money market operations in the United Kingdom:

- changes to the environment in which monetary policy decisions are made, such as the introduction of a new framework for monetary policy and the move towards a low inflation environment, have led to changes in both the timing and, recently, the size of official interest rate changes;
- structural changes in the commercial bill market – the main instrument for money market operations – and the role played by specialised money market intermediaries (discount houses) have led to the addition of a new operating instrument – a fortnightly repo in government debt with a wide range of counterparties.

In addition, four other developments are likely to influence the evolution of the Bank's money market operations to a greater or lesser degree in the future:

- the introduction of an open market in gilt repo in January 1996;
- the introduction of Real-Time Gross Settlement (RTGS) in the sterling wholesale payments system in April 1996;
- work in the EMI on how monetary operations should be conducted in Stage 3 of monetary union;
- the development of new sources of information on market expectations and new techniques for extracting this information.

The main part of this paper describes the questions posed by these developments, and the analysis – and in some cases the actions – the Bank of England has undertaken so far to respond to them. In addition, we discuss some more general issues raised by research on money market operations.

1. Objectives

The objectives of money market operations in the United Kingdom are, in order of importance:

- to steer short-term interest rates consistent with the authorities' monetary policy;
- to enable the banking system to manage its liquidity effectively; and
- to foster the development of efficient markets.

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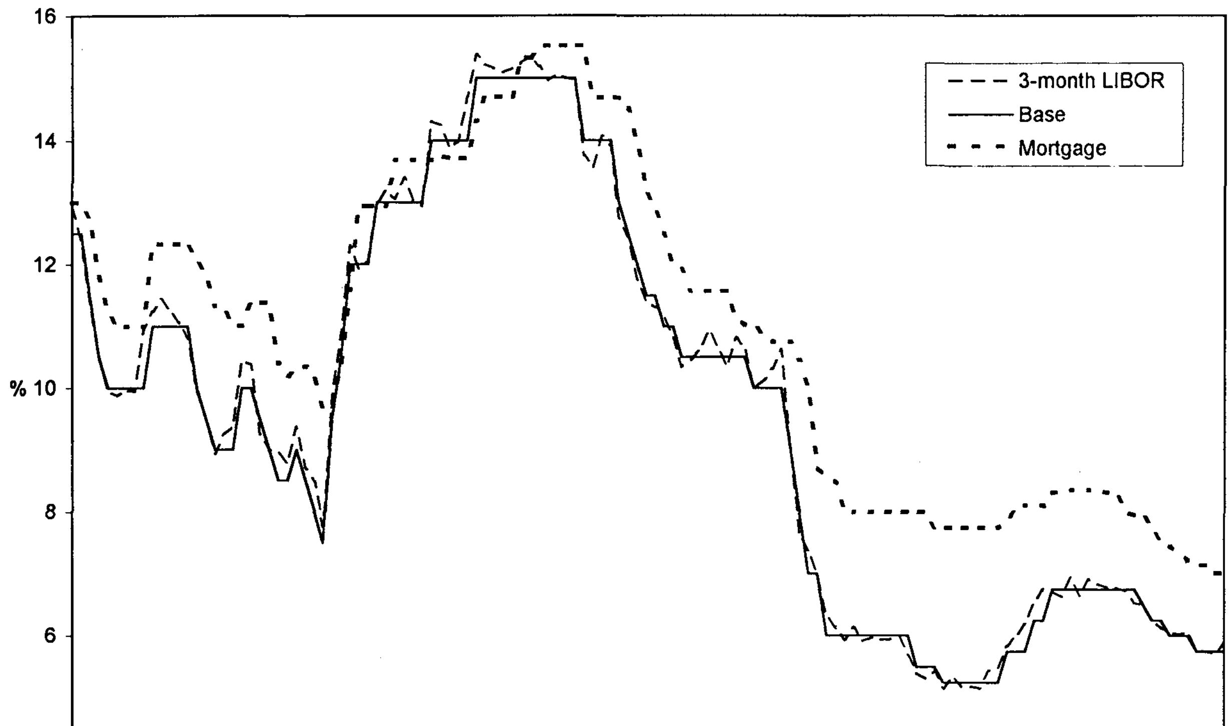
1 The authors are members of the Monetary Instruments and Markets Division and the Gilt-Edged and Money Market Division, respectively. Our thanks go to Mike Cross, Haydn Davies, David Maude and Paul Tucker for very helpful input.

While the maturity of the official interest rate set by the Bank from day to day in its open market operations ranges up to a month, the average maturity is around two weeks. In setting this rate, the Bank seeks to influence a range of short-term rates which directly influence economic behaviour. These include:

- clearing bank "base rates" which are the reference rate for much lending to the personal and corporate sector. In theory an individual bank could change its base rate at any time. However, in practice all the main clearing banks charge the same base rate and change it only in response to changes in official rates.
- bank and building society "mortgage rates", which are also strongly influenced by movements in the official rate, but tend to be set at slightly different levels by the major financial institutions and have a greater degree of independence from official rate movements than the base rate.
- one to three month interbank rates, key reference rates for lending to major corporations in the syndicated loans market.

Chart 1 shows how a selection of these rates have moved over the last ten years.

Chart 1
UK base, 3-month LIBOR and mortgage rates



To aid effective liquidity management, individual banks should be able to obtain short-term funds to meet their own needs and obligations to their customers at any time during normal business hours without triggering a significant change in price. In the United Kingdom only a small group of banks have settlement accounts at the Bank of England. These settlement banks need to manage their liquidity to meet the needs, inter alia, of the non-settlement banks which are their customers.

An efficient market in short-term funds has a number of benefits: in ensuring that changes in monetary policy are transmitted quickly to a wide range of economic agents; in supporting liquidity in markets for other (longer term) instruments; and in enabling agents to discover prices revealing information on market expectations of future interest rates and market perceptions of the credit risk of different bank counterparties. A central bank can help foster such a market by, for example, ensuring that information on its official operations is evenly spread among potential participants, and by ensuring that it does not, through its own actions, reduce the incentive for financial institutions to participate in the market.

It is also desirable as far as possible to have a system in which market forces deliver the required behaviour on the part of commercial banks, rather than having to rely on ad hoc interventions from the central bank. At the same time, the system needs to be able to deal with the accumulation of market power by large institutions – particularly where banking markets are heavily concentrated – and to be capable of evolving gradually in the light of changing circumstances, so as to minimise any risk of a loss of control in monetary policy, or a loss of credibility for the central bank.

2. Changes to the monetary policy context

In the past few years the United Kingdom has seen the establishment of a *new monetary framework* for achieving price stability, and a shift to low inflation. Both these developments have had implications for the Bank's money market operations and sterling money markets.

2.1 New monetary framework

Following sterling's suspension from the Exchange Rate Mechanism (ERM) in September 1992, the objective of monetary policy in the United Kingdom remained the pursuit of price stability, but a new framework for implementing this policy was required to replace ERM membership. As is well known, this was provided in October 1992 by the adoption, for the first time, of an explicit inflation target by the UK Government. A target of 1-4% for the RPIX measure of inflation (consumer prices excluding mortgage interest payments) was set at the outset, with the aim that we should be in the lower half of that range by the end of the current Parliament (taken to be April 1997). This was updated in June 1995 and the authorities now seek to achieve an underlying inflation rate of 2½% or less over an indefinite period.

Under this framework, the Governor of the Bank of England advises the Chancellor on the interest rate policy the Bank believes is necessary to achieve the inflation target, but the ultimate decision about the level of official interest rates remains with the Chancellor. The Governor gives his advice at regular (in practice, roughly monthly) *Monetary Meetings* with the Chancellor which are timed as far as possible to follow the release of a new month's data on the state of the economy (allowing an appropriate period for analysis). The dates of these meetings are published up to 6 weeks in advance. The Bank has discretion over when precisely to implement any interest rate changes which have been decided at these meetings, although in practice it has increasingly chosen to implement changes as soon as practicable after each meeting.

Thus a significant feature of the new framework is greater regularity in, and pre-announcement of, the timing of decisions on monetary policy. This does not rule out changes in interest rates at other times in response to sudden shocks, such as may be reflected in very sharp shifts in the exchange rate or other asset markets. But in the normal course of events the market knows in advance when decisions will be made and when any change in official rates is likely to occur.

Another important feature of the new framework is greater transparency in the advice that the Bank gives the Chancellor, and in the analysis that underlies it. This is in part achieved by the publication of the Bank's quarterly *Inflation Report*, an independent assessment of actual and prospective inflationary pressures in the economy; and in part by the publication of the minutes of each monthly Monetary Meetings two weeks after the next meeting has occurred. A press release is also published by H M Treasury after each interest rate change.

These changes have had a number of implications. First, market participants are likely to be clearer about the information set on which any individual monetary policy decision is made, thereby making it easier for them to identify the authorities' pattern of behaviour in response to news (reaction function). Second, flexibility in the timing of interest rate decisions should be needed only in order to respond to sudden and large economic or financial shocks. Moreover, if such an event were ever to occur, it is likely that the shock which triggered the authorities to act would also be visible to the market, thereby reducing, if not eliminating, the degree to which the action itself was unexpected. Thus, under the new arrangements there should be fewer occasions on which the authorities' behaviour – as opposed to the underlying economic developments – causes uncertainty in the markets. And more generally the enhanced flow of information to the market provides a ready means for the authorities to signal their views on future economic and financial developments. This means that money market operations are no longer the sole means of signalling official views about the future course of interest rates, so they can concentrate on stabilising and maintaining the current official rate.

In practice, the changes described above have not of themselves required any change in the mechanics for setting official interest rates in the United Kingdom. In particular, we have not found that the greater regularity in, and effective pre-announcement of, the timing of interest rate decisions has increased the *general* level of speculation over interest rate moves. In practice, such speculation tends to be focused on release dates for significant data and the days of monetary meetings.

2.2 Low inflation

UK inflation – measured by RPIX – has been below 3.5% since January 1993, while nominal short-term interest rates, at about 6%, are around their lowest level for the past thirty years. In this context the size of the last four interest rate moves has been ¼ percentage point, in contrast to the previous pattern of moves of ½ or 1 percentage point. Indeed the market currently perceives ¼ point change as the norm.

What determines the size of official interest rate steps? Table 1 provides descriptive statistics for official rate adjustments in the United Kingdom, Germany and the United States over the period 1986 to 1996.

In choosing a policy interest rate, we are looking for one that embodies the monetary authorities' view about the appropriate stance of monetary policy. In the case of the United Kingdom, this is straightforward since the authorities only move one rate. However, in other countries, particularly those which operate a corridor system, a number of different rates may be used to signal the authorities view, and the significance of a particular rate may change over time. For this reason the choice of the discount rate in Germany and the United States may not be ideal, but the analysis should provide a useful starting point.

The table shows that official interest rate adjustments in the United Kingdom have tended to be relatively large. In the period 1986-1996, they have averaged 0.7 percentage point, compared to around 0.5 point in Germany and the United States; and this has been the case both for rate increases and decreases. At the same time, rates have changed more frequently in the United Kingdom as compared to the other two countries. Table 1 also shows that when UK official rates have been tightened (+ +), the adjustments have tended to be larger, on average, than those implemented when rates are being eased (– –). This has also been the case in Germany, but the ratio of the average size of continued rate increases to that of continued rate reductions is lower than for the United Kingdom. By contrast, for the United States, the average sizes of the adjustments during tightenings and easings have been equal. In all three countries, the rate adjustments implemented during tightenings have occurred less frequently (i.e. after a longer duration), than those implemented during easings.

Table 1
Adjustments in official interest rates*

	United Kingdom			Germany			United States		
	Number	Average size (p.p.)	Average duration (m)	Number	Averag e size (p.p.)	Average duration (m)	Number	Averag e size (p.p.)	Average duration (m)
Adjustments:									
Increases (+)......	13	0.96	n.a.	11	0.61	n.a.	7	0.54	n.a.
Decreases (–).....	20	0.60	n.a.	16	0.45	n.a.	12	0.52	n.a.
Total.................	43	0.72	3.05	27	0.52	4.33	19	0.53	6.21
Continuations:									
+ +...................	7	0.93	3.00	9	0.64	5.33	5	0.55	5.20
– –....................	24	0.58	2.25	16	0.45	4.44	10	0.55	3.40
Total.................	31	0.66	2.42	25	0.52	4.76	15	0.55	4.00
Turning points:									
+ –....................	6	0.71	23.40	1	0.50	n.a.	2	0.38	61.00
– +....................	6	1.00	20.80	1	0.50	n.a.	2	0.50	80.00
Total.................	12	0.85	22.10	2	0.50	n.a.	4	0.44	70.50
Summary statistics:									
+ / –..................		1.60			1.36			1.04	
+ + / – –	0.29	1.60	1.33	0.56	1.42	1.20	0.50	1.00	1.53

Note: Rates used are: United Kingdom = base rate; Germany = discount rate; United States = discount rate. All are month-end rates; p.p. = percentage points; and m = months.
* January 1986 to August 1996.
Sources: Bank of England and Datastream.

Differences in inflation performance in the United Kingdom compared to the other two countries over the period may be linked to these differences. For instance, the greater variability of inflation in the United Kingdom (implying larger inflation shocks) may have required larger absolute adjustments in nominal interest rates. Table 2 shows that expressing the absolute size of official interest rate adjustments as a percentage of the level of official rates makes behaviour in Germany and the United Kingdom appear more similar. This fits with an explanation based on greater inflationary shocks to the extent that higher inflation volatility tends to be associated with a higher average level of inflation and hence higher average nominal interest rates.

Table 2
Proportionality of interest rate adjustments[1]

Countries	Average level (in percentages)	Average of adjustments[2] (as a percentage of the level)
United Kingdom	9.60	2.56
Germany...	4.95	2.35
United States...	5.23	1.59

[1] Based on the same data as in Table 1. [2] Absolute values.

But changes in *real* short term interest rates are likely to be the main conduit for monetary policy, and it does not necessarily follow that larger changes in nominal rates produce larger changes in real rates, which is what one might actually require to combat greater inflationary shocks.

The greater *asymmetry* in United Kingdom rates may reflect the nature of the exogenous shocks hitting the United Kingdom economy over the period. Alternatively, monetary policy in the United Kingdom may have been more reactive than in the other countries. By the time short-term interest rates were raised, inflationary pressures were already well entrenched, and so relatively large rises in interest rates were then required to bring inflation under control. The United Kingdom's new monetary framework emphasises the need for monetary policy to be forward looking. To the extent that this helps the authorities to react sooner by raising official interest rates in an inflation upswing, it could enable them to move rates by less overall – i.e. "a stitch in time saves nine".

Another factor that may have contributed to both the size and the asymmetric pattern of rate moves in the United Kingdom is that – in contrast to the United States and Germany – the United Kingdom has operated an exchange rate target anchored in effect on another country for a period in the last decade. In these circumstances, and in the absence of close economic convergence with the target country, official interest rate changes may have had to be sharper (for example during the United Kingdom's membership of the ERM) in part to respond to market pressures on the exchange rate target.

Testing these hypotheses is complex since one first needs to separate out all the other influences on the transmission mechanism from the timing and size of official interest rate moves. We are currently conducting research on this issue, but as yet have no firm results to report.

3. Market microstructure

The sterling money markets – unsecured interbank loans, certificates of deposit, Treasury and bank bills etc. – are well established. The greater part of activity remains in the interbank market (but see gilt repo below) with tight spreads ($\frac{1}{16}$) quoted out to 6 months. What follows focuses, however, on the steps taken to reduce volatility at the very short end of the market since the United Kingdom's ERM exit, which created persistent strains for a period.

3.1 Causes and costs of volatility in very short-term rates

Volatility in short-term money market interest rates may occur under *any* system for setting official interest rates as a result of market speculation over future changes in official interest rates. However, the way in which this volatility manifests itself will depend on the form of money market operations and/or standing facilities used by the central bank. For example, in a system with standing facilities for taking in and lending out funds at a particular maturity, volatility at that maturity will be confined to the upper and lower bounds set by the facilities. However, at other maturities rates may rise or fall depending on market expectations.

Equally, if the operating system includes periodic monetary decision points, and the market expects the official rate to rise at the next decision point, there will be a tendency for participants to borrow as much as they can for maturities spanning the next decision point, while lending out the proceeds so that they mature before the decision point. In the case where the maturity at which the central bank provides liquidity does not span the next decision point, this will tend to push up longer term rates until the underlying implied forward rates are consistent with the market's expectations for the future path of the official rate. However, in a system – such as those in the United Kingdom or Germany – where the central bank may conduct open market operations setting an official rate whose maturity overlaps with the date of the next normal decision, market participants will have an incentive to borrow as much as they can from the central bank in its open market operation, and then lend the proceeds out short-term so that they can be relent later on at the higher rate. This may depress very short-term rates below the official rate and could add to their volatility as the market's view over the likelihood of a rise in official rates varies.

Other possible causes of volatility include errors by the central bank, or its counterparties, in forecasting the amount of funds the market needs to meet its reserve requirement at the end of the maintenance period; and non-competitive behaviour among participants in the market for central bank funds.

It is unlikely that any of these kinds of volatility matter much for the first objective of money market operations – steering key lending and borrowing rates in line with the monetary authorities' monetary stance. This view is supported by econometric studies that have examined UK overnight rate volatility transmission along the yield curve. For example, Ayuso, Haldane and Restoy (1994) employed ARCH techniques to assess the extent of any volatility spillover to one-month, three-month and one-year rates, using daily data for the period 1988 to 1993.[2] They found statistically significant volatility transmission effects only at the three-month maturity, but the extent of the spillover was quantitatively small.

However, short-term volatility may matter for other reasons:

- Some users of the market may be relatively uninformed about the speculative behaviour underlying short-term rate moves. For these participants, uncertainty in the overnight funds market may disrupt their liquidity management, or at least force them to pay for insurance against unexpected movements, and make it harder for them to interpret market expectations on the future course of official rates.
- Average volatility arising from forecast errors could have costs for all participants in the market and may, in certain circumstances, be reduced by lengthening the maintenance period over which average reserves have to meet the required level (see the later discussion of Monetary Union).
- Volatility may be a symptom of the accumulation of market power by certain market participants.

Accurate measurement of overnight volatility is difficult because the picture can vary a lot according to the time of day that rates are measured – a system with low volatility in business hours may have much higher volatility out of hours. Chart 2 shows volatility in UK overnight rates (adjusted for changes in official rates) over the past ten years. In this case the overnight rate is measured at 8.30 a.m. each morning. Charts 3 and 4 show alternative representations of the same raw data – a monthly average of the absolute difference between overnight rates and official rates, and a 250-day rolling standard deviation for policy adjusted overnight rates. Lastly, Chart 5 shows the daily highs and lows in the overnight rate over the same period.

One way of gauging the potential costs of this volatility is suggested by Lippman and McCall (1986), who argue that the volatility of interest rates at a particular maturity is inversely related to the liquidity of financial instruments of that maturity. One way of measuring the liquidity of overnight instruments is to calculate the spread between overnight LIBOR and LIBID; expressing this as a percentage of LIBID gives the "mark-up", which may provide a more useful metric for making comparisons of market liquidity over time.[3] Chart 4 also shows the mark up on overnight interbank rates over the past ten years and suggests some degree of correlation between this and the rolling standard deviation measure of volatility. More generally, the clear picture is that overnight volatility in the United Kingdom has varied considerably over-time, but has been falling since 1994 and is now

2 Replicating this approach using daily data for the period 1988 to 1996 did not materially affect the results of this study.

3 This is because, unlike the spread, the mark-up is invariant to the level of overnight rates.

at its lowest point over the past six years. Developments in the structure of the market for central bank funds may explain to a large degree the rise and fall in overnight volatility in the United Kingdom.

Chart 2
Overnight LIBOR less base rate

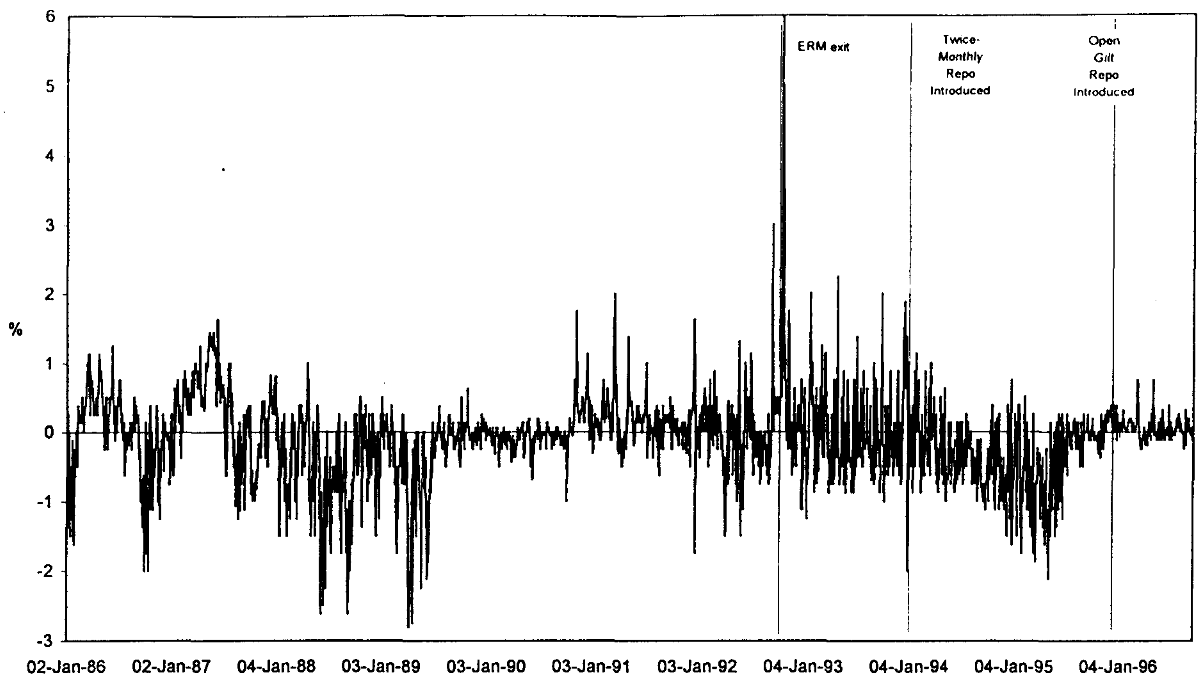


Chart 3
Monthly mean absolute difference: overnight LIBOR less base rate

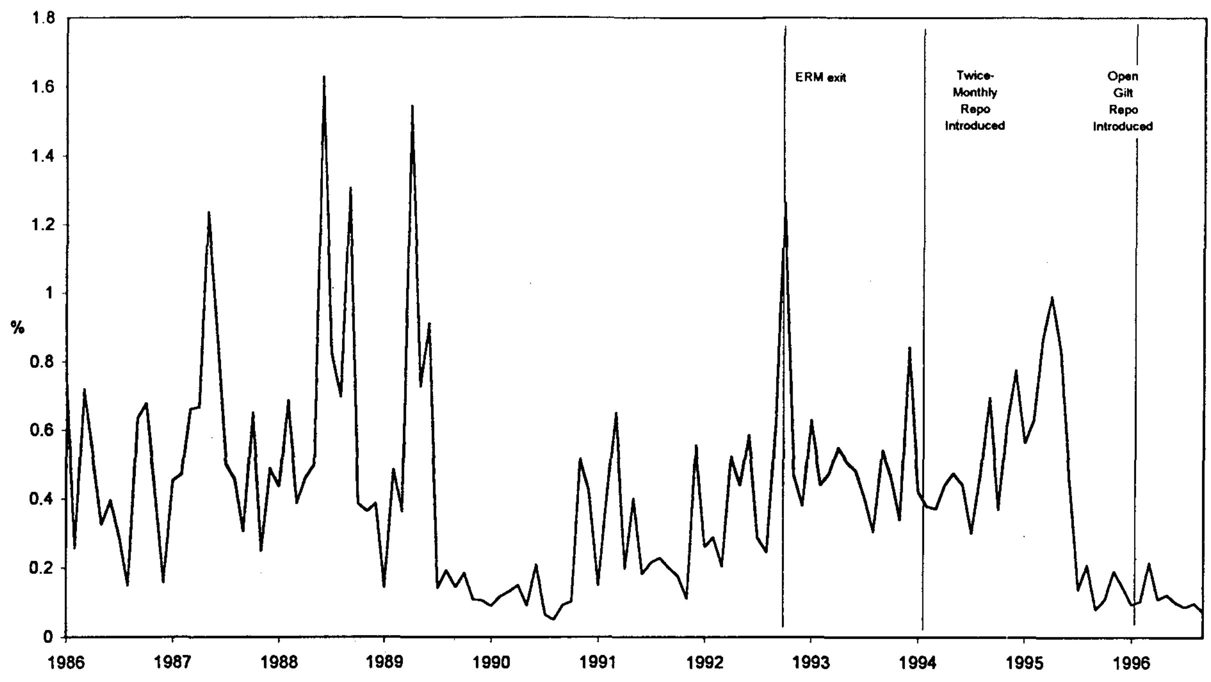
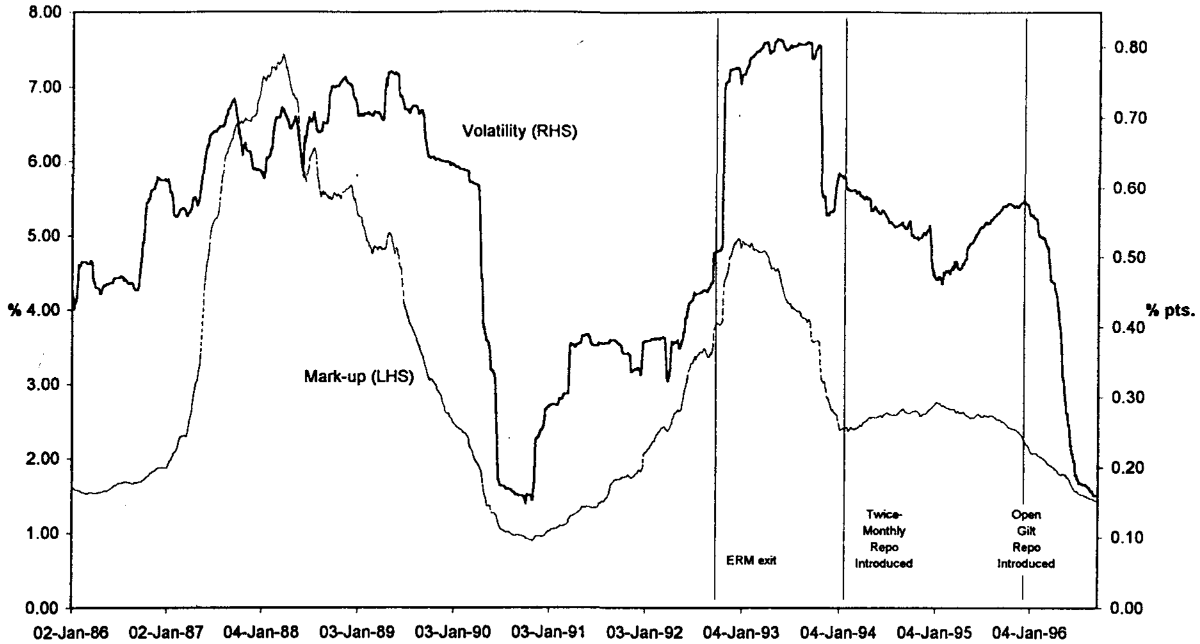
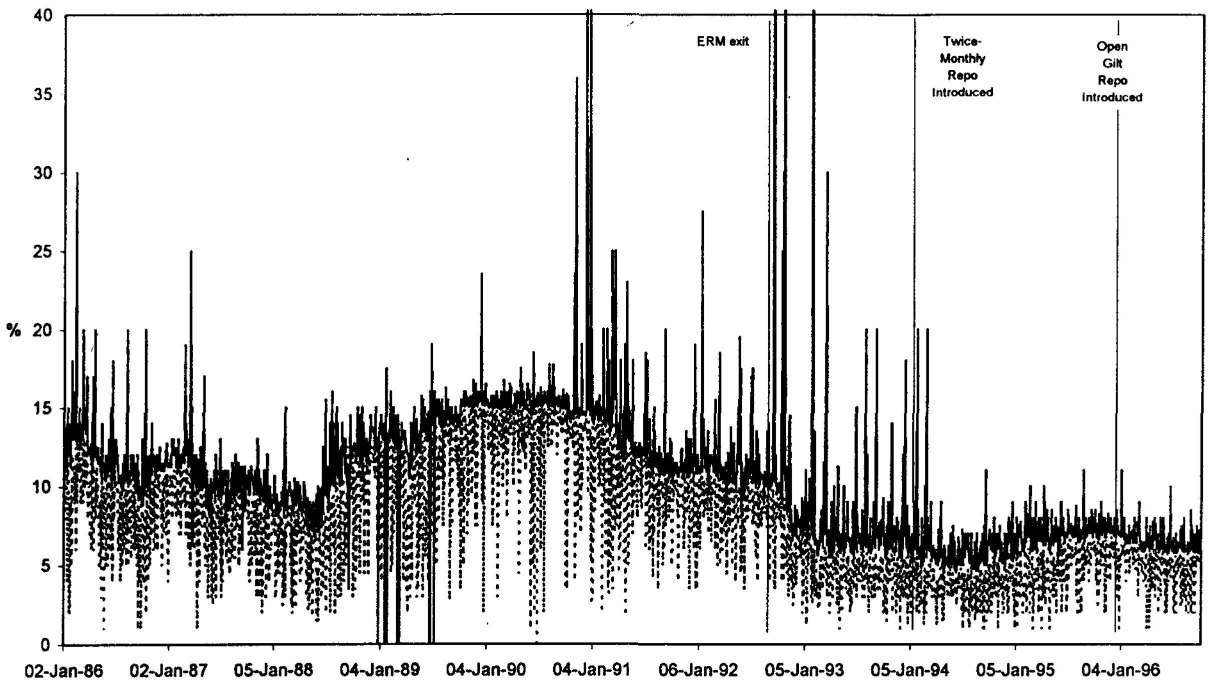


Chart 4
Policy-adjusted overnight LIBOR volatility and mark-up



Note: Volatility is defined as the standard deviation, computed using daily data, over rolling 250-day periods; mark-up is defined as the spread expressed as a percentage of LIBID, computed as a rolling 250-day average.

Chart 5
Overnight LIBOR: daily highs and lows



3.2 Strains in the bill market

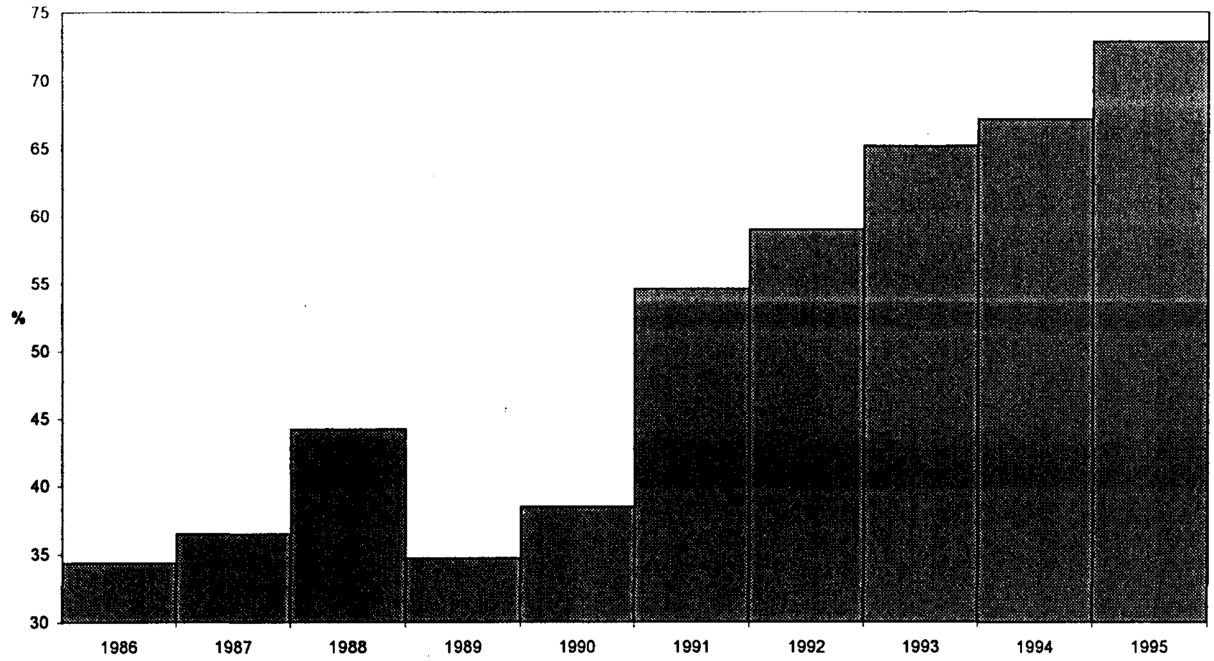
The Bank has traditionally conducted its money market operations in bills – public sector bills (largely Treasury bills) and "bank bills" (private sector obligations which are accepted by a bank and meet certain other requirements). It has also traditionally dealt with the discount houses – specialist money market banks which make markets in bills and offer secured deposit facilities to the rest of the banking system. The traditional arrangements (as revised in the 1980s) were designed to allow cash surpluses and deficits among the banks to be equilibrated in the money markets – including the bill markets and the market in secured deposits – while allowing the Bank of England to provide the liquidity needed by the system as a whole by buying bills (outright or on repo) from the discount houses. Since settlement banks have to keep their accounts at the Bank in credit each day (and there are no reserve requirements with averaging provisions) the Bank offers to provide its estimate of the system's need each day.

A number of structural developments have put these arrangements under strain in recent years. First, the bill markets have not grown in line with the balance sheet of the banking sector. The government has not relied on Treasury bills as permanent finance, and the share of commercial bill finance in bank lending has been in secular decline. Moreover the discount houses have also not grown in line with the banking system in general – until the beginning of 1996 when the introduction of a gilt repo market (see below) brought mergers with other institutions and new business opportunities.

Perhaps more important, the traditional arrangements relied on the banks holding a proportion of their liquidity as secured deposits with the houses, but this requirement was removed in 1986, and some of the large banks have since then taken the opportunity to manage their liquidity by holding larger amounts of bills on their own balance sheets, and holding correspondingly fewer secured deposits with the discount houses. Chart 6 shows how the big four clearing banks' share of bills has increased rapidly since 1990. Although the Bank still deals with the discount houses in its

Chart 6

"Big 4" clearing banks' bill holdings as a percentage of total non-official holdings



Note: "Big 4" clearing banks are: Barclays, NatWest, Lloyds TSB and Midland; end-year figures.
Sources: BBA Annual Abstract of Statistics (1996) and Bank of England Monetary Statistics.

daily operations, the houses have had to rely much more on obtaining bills from the large banks to "put through" to the Bank of England, to the point where some have been willing to do this at no charge to the banks.

Assets eligible for use in the Bank's operations can from time to time be concentrated in relatively few hands. This gives a degree of market power to those institutions which do hold paper eligible for use in the operations. Some are sufficiently large that overnight rates have been significantly affected by their decision to take part or not to take part in the daily operations.

The extent of these strains depends on the circumstances. At times, if the amount of central bank refinancing of the banking system was large (see Bank of England, 1995a), then the Bank could find itself owning a significant part of all the bills that were in the market, and mobilising remaining bills through operations could become more problematic.

3.3 The Bank's response – the fortnightly repo[4]

After the large scale foreign exchange intervention of 1992 this potential problem was very great, and the Bank had recourse to alternative ways of providing finance. It provided finance using a different instrument – repos of government bonds (gilts) rather than bill transactions – and with a wider set of counterparties – not just the discount houses but also large banks and building societies and its counterparties in the gilt-edged market (gilt-edged market makers).

At first this supplementary finance was provided on an ad hoc basis, but since early 1994 has been regularised in twice-monthly repo operations (known as *rough tuning* operations) available to all banks and building societies and to the gilt-edged market makers. This extra facility has operated as a useful safety valve, with take-up tending to grow when the scale of refinancing would otherwise have put strain on the bill market. Charts 2 to 5 confirm that overnight volatility has been significantly reduced since the introduction of the fortnightly repo, although a precise link can only be made under some of the measures.

4. Open gilt repo market

At the time the twice-monthly repo facility was introduced there was no private repo market in gilts. But since 2nd January 1996 trading in gilt repo has been fully liberalised.[5]

While gilt repo was introduced to help promote the liquidity and efficiency of the gilt market, it also has implications for the sterling money markets. Most obviously, it provides another way of trading secured money, which has the potential to expand given the large size of the gilt market, and the wide dispersal of holdings.

The new market has expanded progressively. By the end of August, there were thought to be around 100 firms participating in the market, drawn from a wide range and including clearing banks, discount houses, major European banks, international securities houses, Gilt Edged Market Makers, long-term institutions, and some building societies. From data reported by around 70 of the main participants, we estimate that by end-August the repo market had reached at least £60 billion outstanding. The data suggest that the average turnover of the gilt repo market is about £15 billion per day. Activity is considerable out to three months and goes out to a year. It is possible to trade in size up to £400 million at 3 months, and up to £200 million further out.

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4 See Bank of England, 1994a and 1994b.

5 See Bank of England, 1995b, 1995c, 1995d, 1996a.

It is possible that the development of the gilt repo market may have also contributed to the reduction in overnight volatility – see Chart 4. This could be because institutions without large holdings of bills are finding it easier to redistribute surplus liquidity among themselves, particularly early in the day when bond inventories are typically financed. It may also be that smaller commercial banks are less constrained by their relative credit standing – so that they can deal in larger amounts and may be less concerned to tie up their daily requirement for funds early in the day; gilt repo puts them on a more equal footing with other, larger, counterparties.

With the opening of the gilt repo market it was envisaged that at some stage this instrument might be incorporated in money market dealing operations once the market was sufficiently well developed (see Plenderleith, 1996). That point may now be approaching. A number of potential advantages are already clear:

- there are £250 billion of gilts outstanding (compared to around £20 billion of commercial bank bills and around £10 billion of Treasury bills) so operations in gilt repo are much less likely to be constrained by a shortage of the underlying key instrument;
- the breadth of participation in the market to date, combined with the broad spread of holdings of gilts, suggests that a wide range of financial institutions would be able to participate in open market operations in gilt repo;
- repo would allow the Bank to use open market operations to set an official short-term interest rate at a maturity of its choice each day. With the current system relying largely on outright purchases of bills, it offers to buy bills over a range of maturities (typically up to one month), because there are insufficient bills of each maturity to restrict operations to a single maturity.

The Bank has already added to the list of instruments it will accept in its daily operations by offering to repo the government's *floating rate* gilts[6] alongside repos of bills.

5. Real-time gross settlement

The system of daily money market operations of necessity requires same-day payment and settlement arrangements. These are provided, for bills, by the Bank's Central Money Markets Office (CMO) and, for gilts, by the Bank's Central Gilts Office (CGO). At present, the payment arrangements for CMO and CGO are based on end-of-day settlement, but since April 1996, the main wholesale payments system in the United Kingdom (CHAPS) has operated on the basis of real-time gross settlement (RTGS) and we are currently studying how, in due course, to settle obligations between settlement banks in CMO and CGO in real time on a gross basis.

The move to RTGS has meant that banks now require explicit intra-day liquidity; they can no longer wait for payments to be netted off at the end of the day. One way for banks to deal with the scale and asynchronicity of their payment flows would be to hold settlement balances sufficient to cover their largest cash outflows. In practice, however, banks prefer to finance at least part of their outflows by borrowing intra-day funds. The Bank has decided to meet this additional demand for intra-day liquidity by providing fully-collateralised intra-day loans at zero cost. This ensures that the Bank is fully protected against credit risk on its intra-day lending while minimising the cost to the economy of the move to RTGS.

This development has not had any effect on the way official interest rates are set for maturities of one day or longer because the Bank insists that all intra-business day loans must be

[6] Floating rate gilts have their coupon refixed every three months, and thus behave very much like money market instruments.

repaid before the end of the business day. This makes it impossible for a bank to substitute a combination of free, or nearly free, intra-day loans for a one-day loan. If a bank wishes to borrow for a maturity that extends overnight, it has no option but to borrow for one day (or longer) at the market rate consistent with the Bank's official interest rate, or incur an unauthorised overdraft and the associated penalty interest rate.

Theoretical analysis suggests that a parallel interbank market for intra-day funds (or eligible collateral) could still emerge, given that the official facility is not open 24 hours a day and if, for example, banks were to find that there was an opportunity cost in obtaining intra-day funds from the central bank because of a shortage of the right kind of collateral. And this in turn could lead to the extension of the yield curve back beyond its current shortest maturity of one day (see Dale and Rossi, 1996). However, even in this event, the central bank's ability to control short-term interest rates should not be affected provided it maintains a rigorous segmentation between its intra-day and overnight lending, with the latter carrying the same cost regardless of how many hours the loan is actually outstanding.

6. European Monetary Union

Although many EU countries have reduced the level of reserve requirements in recent years – in part reflecting our own concern over the tax that this imposes on financial intermediation – the United Kingdom is still relatively rare in having a system with (almost) zero reserve requirements. Another important distinction in our system is the use of a daily maintenance period – i.e. there is no averaging.

In discussions on the most appropriate system for implementing monetary policy in a monetary union, it has sometimes been argued that averaging and positive reserve requirements are closely linked, essentially because a buffer stock of reserves is needed to absorb daily reserve shocks, thus reducing short-term interest rate volatility. But as we see it, this interest-rate smoothing function could also, in principle, be achieved with a buffer stock of reserves provided to banks through fully-collateralised overdrafts from the central bank. So smoothing can be separated from the size of positive reserve requirements, and would indeed be provided through averaging around a zero reserve requirement. And this would avoid the potentially distorting impact of a positive reserve requirement.

To investigate the possible implications of such an arrangement further, we have constructed a theoretical model (see Davies, 1996). In this, banks have a zero reserve requirement which they are expected to try and meet over a maintenance period which may be one day or longer. The central bank is assumed to use daily open market operations to meet the demand for funds that arises as a result of persistent money-market shortages. In conducting its operations, the central bank forecasts demand for reserves at the start of each day. On any given day, banks are subjected to reserve shocks; and these cause the central bank to make errors in its forecast since it will not observe the (net daily) shock until settlement at the end of the day. Banks have automatic access to fully collateralised overnight overdrafts at the central bank at any time within the maintenance period (except the last day). The model assumes that the central bank adjusts its target for the interest rate only at the start of the maintenance period. (This has the effect of avoiding any speculation about changes in the official rate within the maintenance period.)

Overall, the conclusion of the model is that such a system could stabilise money-market interest rates and that positive reserve requirements are not needed to confer the supposed benefits of averaging. There are three key results.

The first relates to the level of the penalty for being overdrawn at the end of the maintenance period. According to the model, the central bank should set the penalty for missing the reserve requirement at twice the market rate of interest on the last day of the maintenance period. By doing so, the central bank will induce the banks to try to meet precisely the zero reserve requirement.[7] And the central bank should not charge for intra-period overdrafts – the whole of the penalty should be levied at the end of the maintenance period. Intuitively, the relevant consideration for a bank in deciding on a target level of reserves is the cost it still has to pay if it does not meet the reserve requirement, rather than the costs it has already paid. Only if overdrafts are free will the cost of missing the zero cumulative reserve requirement be twice the market rate of interest both before and after any shocks.

The second result relates to the effectiveness of zero averaging. On all but the last day of the maintenance period, the central bank, in response to daily reserve shocks, is able to adjust its supply of reserves (with a lag) to the quantity demanded in order to maintain the short-term interest rate at the target level. The banks know this and therefore do not need to respond immediately to reserve shocks. For example, assume that a bank faces a negative reserve shock on the first day of the maintenance period; this will raise the amount that the bank needs to borrow in order to meet the zero reserve requirement. But if overdrafts are free (including no shadow cost from collateralisation), the bank only needs to be concerned with the possibility of missing the requirement for the period as a whole, and with the cost of borrowing the necessary funds to avoid this happening. If it borrows more immediately, this would drive the interest rate higher. But by postponing this borrowing until later in the maintenance period, the bank will be able to borrow at the central bank's target rate. As a result, over the maintenance period, interest rates are smoothed – errors in the central bank's forecast have no effect on the market rate (except on the final day).

The third result relates to the frequency and timing of the central bank's open market operations. The benefits of averaging can still be obtained if the central bank operates frequently, say daily (although it should not have to do so). Money-market interest rates will become volatile after the central bank has completed its last operation of the maintenance period since there will be scope for the last reserve shock to move market rates away from the target level. The central bank can minimise this volatility, however, by operating as late in the maintenance period as possible.

The simplicity of the underlying model means that these results cannot be translated directly to a real world environment, but they do provide a useful illustration of the processes at work. There are a number of ways in which the model might be extended. For example, to try and take account of the possible moral hazard concern when banks go overdrawn at the central bank (albeit on a collateralised basis), or to consider the potential trade-off between lengthening the maintenance period to reduce average volatility in overnight rates, and shortening it to give the authorities the maximum scope to change interest rates in response to news in a timely fashion. It may also be worth considering how to construct an optimal regime for allowing banks to carry forward reserve surpluses or deficiencies. A key feature of the model is that the central bank's counterparties are characterised as a single representative agent. Hence it abstracts from the accumulation of market power by individual banks. A further extension would be to relax this assumption.

7. Other research

Below we comment on two further research questions on the form of money market operations. These are also considered in the context of a one-day maintenance period with zero reserve requirements.

7.1 Maturity of official interest rates

Does the choice of maturity for the official interest rate matter? For instance, can it give the central bank more or less influence on the key rates that it wishes to influence?

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7 This is a generalisation of the Poole's "two-times" rule, derived for a one-day maintenance period.

Intuitively, rates set by the banking system – whether longer-term market rates, such as the three-month interbank rate, or "sticky" administered rates such as base rate or the mortgage rate – will depend in the main on the market's expectations about the future course of the official rate (although other factors, such as competitive conditions in lending markets, may play a role from time to time). Provided official rates change relatively infrequently, the market will assume that when the rate changes the new level is likely to be held for some time and will set market and administered rates accordingly. In this world the choice between setting a very short official rate – such as the overnight rate – and a slightly longer-term rate – such as over a fortnight – ought to have few if any implications for the degree of influence that the authorities can exert on longer-term rates.

To check this intuition we constructed a simulation model examining the volatility in market rates at maturities ranging from overnight to three months that would arise under different assumptions about the maturity of a central bank's daily operations (see Davies and Maude, 1996). We assumed a simple policy rule to determine the central bank's response to random inflationary shocks and assumed that the market knew this with certainty. This enabled us to model the market's expected path for short rates at any point in time (abstracting from time varying risk premia). The model was then calibrated to accord with certain stylised facts about how the United Kingdom has historically managed its official rate (including the frequency of changes, the number of turning points etc.) and simulated a hundred times for each maturity of the official rate. The results confirmed that a central bank behaving broadly as the UK authorities have done in the past should be able to steer 2- and 3-month interest rates under all three of the assumed operating maturities. However, operating at a very short term rate (at the limit the overnight rate) tended to minimise volatility in very short-term rates.

There are clearly a number of caveats with such a simple model – including the assumptions about the process by which expectations are formed, the absence of time varying risk premia, and the assumption of a representative agent for the central bank's counterparty (ruling out the exercise of market power). However, the results do suggest that operating at very short-term rates does not reduce the central bank's ability to steer longer term rates consistent with monetary policy.

7.2 Penalties for unauthorised overdrafts

Central banks may wish to minimise the extent to which banks behaving optimally go into unauthorised overdraft at the end of the maintenance period because, for example, it would then be clear if a bank was not managing its liquidity properly. Is it possible to design a formula for penalising unauthorised overdrafts at the end of the maintenance period which achieves the desired outcome while relying entirely on financial means as opposed to non-financial means, such as moral suasion from the central bank?

The Poole (1968) "two-times rule" – in which the penalty rate is set at two times the market rate (equivalent to the rate in the central bank's open market operations) – gives participants the incentive *to target* a zero balance at the end of the maintenance period, but it does not guarantee that banks will meet that target – even in a world with no speculation. In a system with zero reserve requirements, and assuming symmetric shocks, this means that banks would be overdrawn on average half the time. Indeed, for an economy with a pattern of shocks like that of the United Kingdom, the penalty for unauthorised overdrafts would need to be of the order of twenty times the market rate of interest in order to ensure that banks only went overdrawn 5% of the time. Interestingly few, if any, central banks charge such steep penalties as a matter of course; indeed they prefer to rely on additional non-financial penalties. This may reflect past convention and what is perceived as acceptable by the banks.

8. Information flows

8.1 The information provided by the Bank of England

Market efficiency should in principle be served by publishing as much relevant material as possible on liquidity conditions and central bank operations. This levels the playing field between large and small participants in the market. It may also improve the quality of information, on liquidity conditions held by the market (although there is a potential incentive problem insofar as the information provided by the central bank may reduce the incentive for private banks to look for information, some of which the central bank may not have). What is relevant will vary from one system to another. In the United Kingdom the fact that banks must meet a daily balancing requirement means that the Bank publishes a lot of information on both liquidity conditions and its own operations:

- it announces all invitations to bid in open market operations – both for daily operations and for the twice-monthly gilt repo facility – through the wire services; it also publishes the amount of assistance provided on the wire services shortly after the allotment details have been calculated, and before the details of the allotment are communicated to individual counterparties;
- at around 9.45 a.m. the Bank publishes its forecast of the day's shortage and updates are published subsequently if the position deviates materially from this. It also publishes a brief summary of the main components of the daily shortage (government transactions, the maturing of previous official operations, variations in the note issue, etc.).

8.2 New sources of information

Market expectations of interest rate moves are an important ingredient in formulating monetary policy. This is partly because they provide a check against our own analysis of economic and monetary policy developments, and partly because they yield information on the credibility of any particular monetary regime. Separating out these elements may not be at all easy. The extent to which any individual central bank can extract expectational information depends on the availability of particular instruments and the depth of the markets in them.

In the United Kingdom, we have traditionally monitored a range of interest rate (price) and quantity variables for information on market expectations, as well as talking to the market directly to gauge their views. In recent years the development of the short sterling future (SSF), a future on the three month interbank rate, has added an easily read source of information on changes in the market's expectations of short-term interest rates at, currently, twelve future dates.[8]

However, at times the levels of rates signalled by the SSF have seemed implausible, and so there is generally some caution in using it as an indicator of the expected level of short-term interest rates. Possible reasons for this include the presence of liquidity premia – particularly for contracts further out – and changes in the credit risk of the underlying interbank rate. But it may also reflect the fact that the future tells us the *mean* of the market's distribution, which might be some way from the most likely (*mode*) outcome (see below).

There are also limits in the extent to which one can use the SSF to discern market expectations about near-term policy moves. This is because the clearing bank base rate is in principle an overnight rate in the sense that banks have the right to change it whenever they wish. And so a

[8] The long gilt future has to some extent performed a similar role for near-term expectations of changes in long-term rates. However, it is more commonly used as a proxy for changes in long rates themselves.

future three-month interbank rate taken from the SSF will reflect the *average* base rate over that future three-month period. If official rates are expected to rise, a given expected interbank rate may be consistent with a lower expected base rate for the same date. Differences may also arise due to the fact that the interbank rate is a market rate which is actually charged by banks to borrowing banks, while the base rate is a reference rate for bank lending to corporate borrowers who typically pay a margin on top. The difference between the two rates will therefore be affected by changes in the credit quality of banks versus corporates, and by the degree of competition in the corporate loan market.

Recently the Bank of England – and other central banks – have developed a technique for estimating the market's complete *risk neutral probability density* (RND) function for an asset price on a particular date in the future[9] (see Bahra, 1996, and Bank of England, 1996b). This information is derived from the prices of options on short interest rate futures. Imagine an option that gives the holder the right to buy an interest rate future at a particular price – the exercise price – on a particular date in the future. Now imagine an option with a slightly higher exercise price. The difference in the price of these two options reflects the value attached to the ability to exercise the options when the price of the underlying future lies between the two exercise prices. That in turn will depend on the probability of the underlying futures price lying in the interval.

Charts 7 and 8 provide recent examples of RND functions for UK and German short-term rates in December 1996 and March 1997. Charts 9 and 10 show how certain key summary statistics – mean, mode, upper and lower quartile – for the December sterling and Deutsche mark RND functions have changed over time. And Charts 11 and 12 shows how these statistics vary looking into the future (over the currently traded range of contracts). Several features stand out. First, the standard deviation of interest rate expectations in Germany is less than that of interest rate expectations in the United Kingdom, and, as one would expect, the standard deviation for both distributions declines as the terminal date for the contract is approached. Also the distributions tend to be positively skewed, and the extent of the skewness increases the further into the future you look. This may in part reflect the range of possible outcomes in each country – for example uncertainty about the outcome of the UK general election which must be held by Spring 1997 – but it could also reflect a natural skewness arising from there being a non-negative constraint on nominal interest rates.

As an operational tool, RND functions may give authorities more information on how the market is likely to react to a change in official rates. For example, a decision to raise short-term interest rates may have a different impact on market perceptions of policy when the market appears to be very certain that rates will *not* change (as evidenced by a narrow and symmetric RND function) from when the mean of the probability distribution is the same, but the market already attaches non-trivial probabilities to sharply higher rates. Equally, RND functions may help in ex post analysis of the market's reaction to particular policy actions.

In both cases, the key issue is how much *incremental* information is provided by the RND functions vis-a-vis the mean of the distribution which is already visible from short-interest rate futures, and how reliable this is (taking account of variable liquidity in options contracts). Chart 13 provides a recent example of value added in the United Kingdom where, over a period of a week in September 1996, the mean of the distribution for short-term sterling interest rates in March 1997 changed little, but the probability of rates being below the present level in March 1997 fell substantially from 28 to 20%. Much of the change occurred on a day on which a monthly Monetary Meeting produced no change in official rates.

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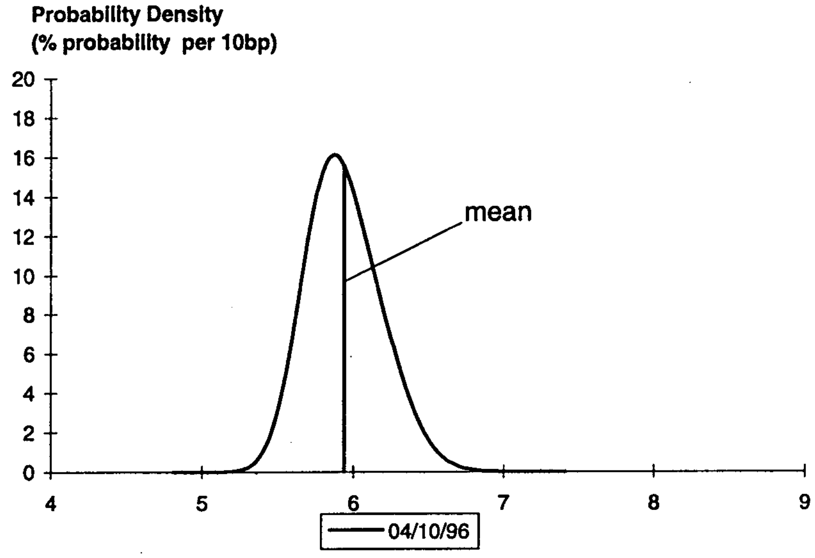
9 The density function derived is for a risk neutral representative investor; so if market participants are risk averse the estimated distributions may differ from "true" market distributions.

Chart 7

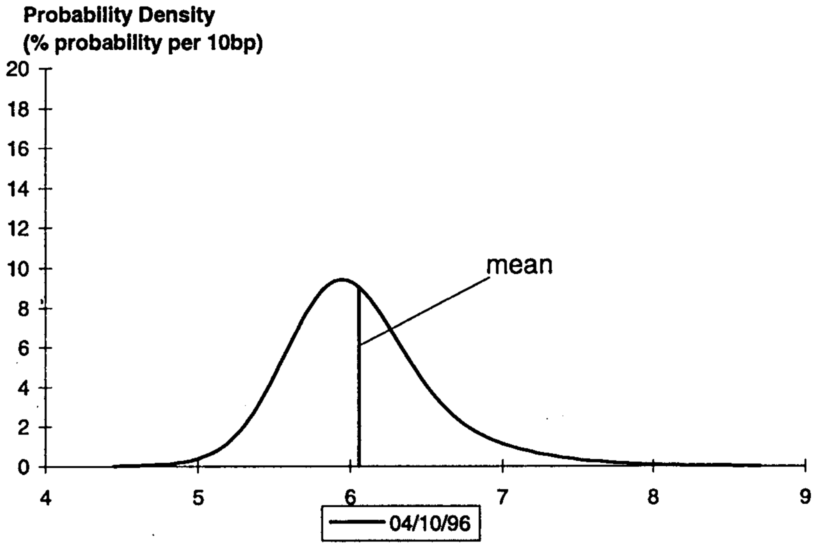
Implied probability densities for 3-month sterling interbank interest rates at futures dates, as at 4th October 1996

18 December 1996



	04/10/96
Mean	5.94
Mode	5.87
Mean - Mode	0.07
Standard Deviation	0.25
Interquartile Range	0.34
Skewness	0.34
Kurtosis	3.01

19 March 1997



	04/10/96
Mean	6.06
Mode	5.94
Mean - Mode	0.12
Standard Deviation	0.50
Interquartile Range	0.59
Skewness	0.80
Kurtosis	4.66

Notes: [1] Distributions are derived from option prices on the short sterling future. To the extent that agents are risk averse, their "true" probability distributions may differ in some degree from those shown.

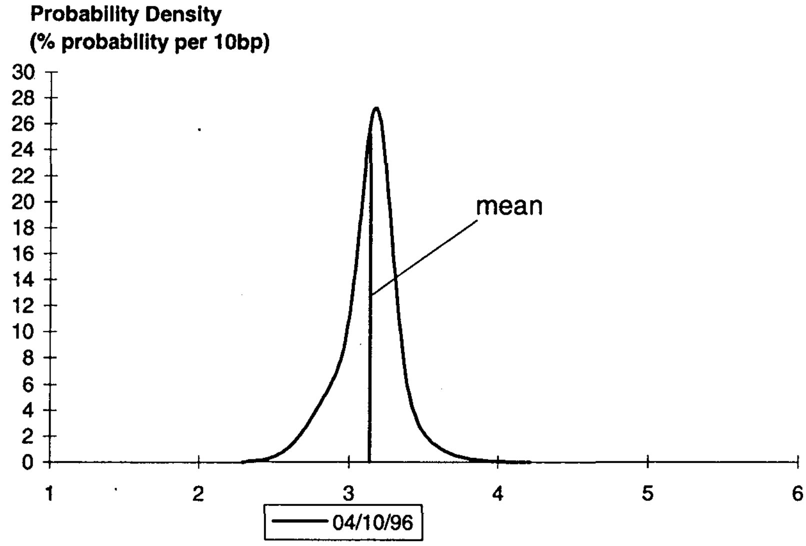
[2] To avoid the problems associated with non-synchronised data, LIFFE settlement prices are used.

[3] The "mean" is the expected value of the distribution; this is equivalent to the value of the underlying interest rate future. The "mode" is the most likely outcome.

[4] The "probability density" indicates the likelihood of particular events occurring. Thus the probability density associated with interest rate x is approximately equal to the probability of the outcome lying in a corridor 5 basis points either side of x. Moreover, the probability of the rate lying between x% and y% at the terminal date is given by the area under the probability density curve between those two points. The area under the whole curve is always 100%.

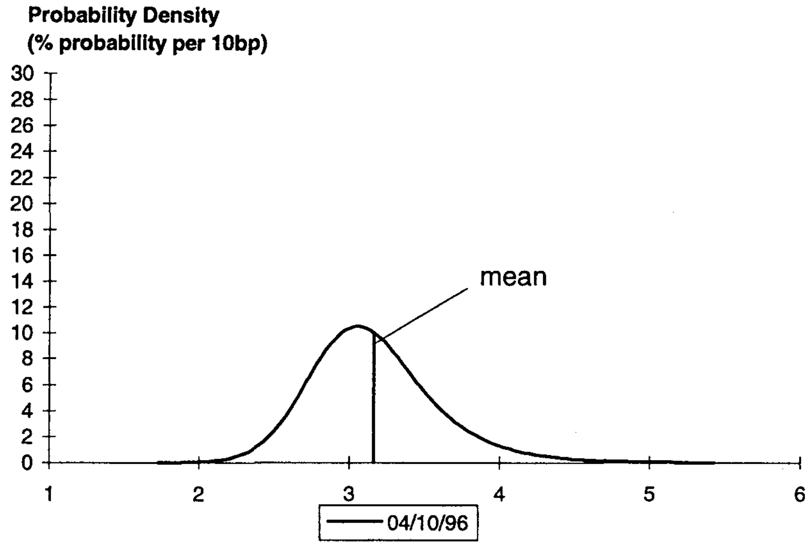
Chart 8
Implied probability densities for 3-month Deutsche mark interbank interest rates at futures dates, as at 4th October 1996

16 December 1996



	04/10/96
Mean	3.14
Mode	3.17
Mean - Mode	-0.04
Standard Deviation	0.20
Interquartile Range	0.21
Skewness	-0.23
Kurtosis	4.39

17 March 1997



	04/10/96
Mean	3.16
Mode	3.05
Mean - Mode	0.11
Standard Deviation	0.43
Interquartile Range	0.53
Skewness	0.71
Kurtosis	4.25

Notes:Distributions are derived from option prices on the short euromark future. For further explanation, see the notes to Chart 7.

Chart 9
Implied probability distribution summary statistics for the 3-month sterling interest rate in December 1996

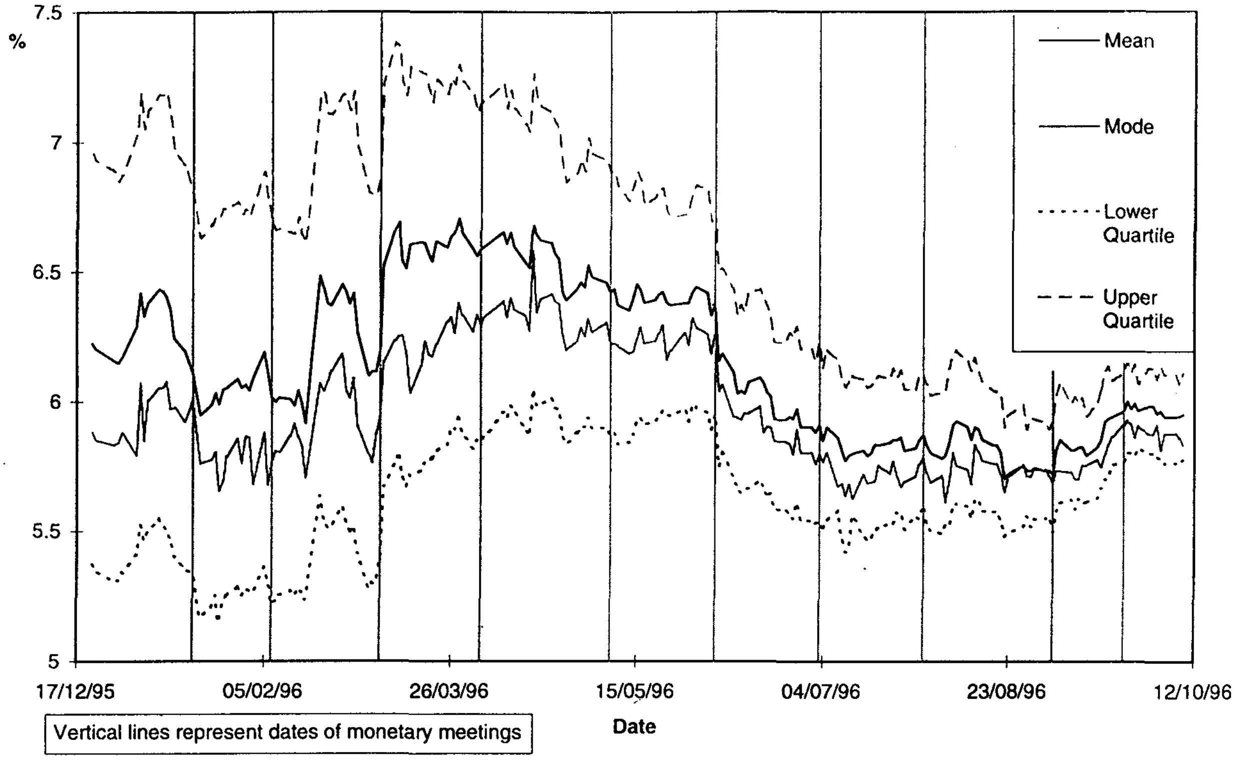


Chart 10
Implied probability distribution summary statistics for the 3-month Deutsche mark interest rate in December 1996

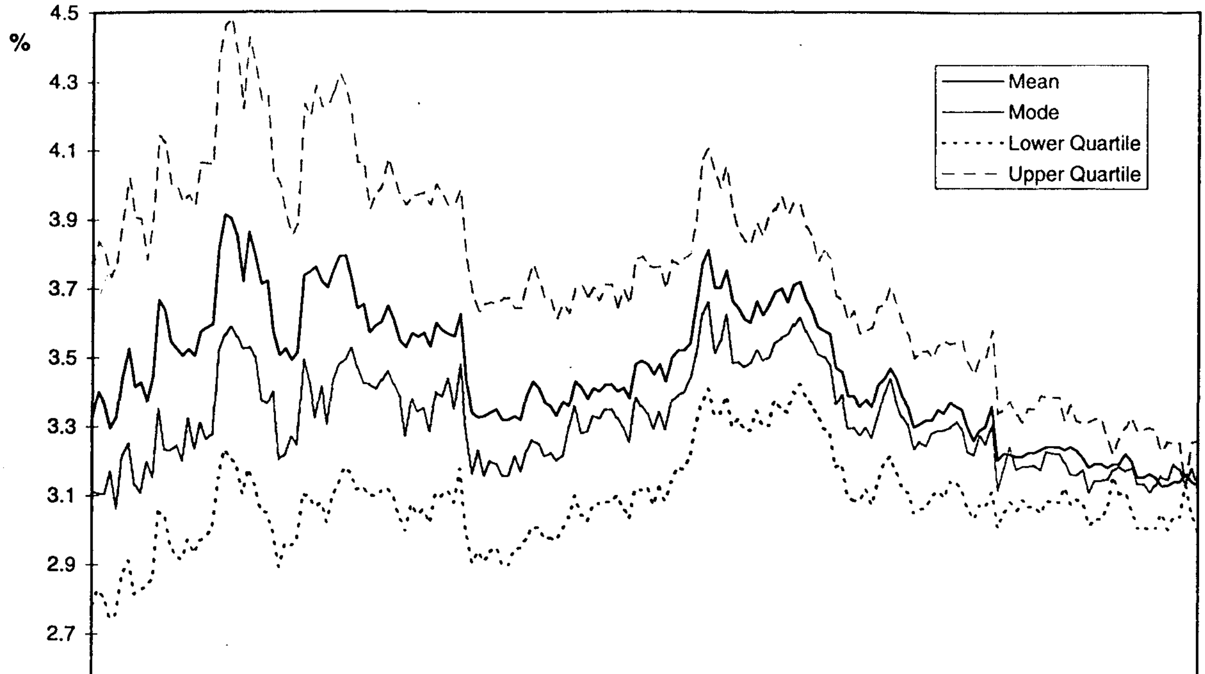


Chart 11

Three-month sterling interest rate as at 4th October 1996 and implied probability distribution summary statistics for future dates

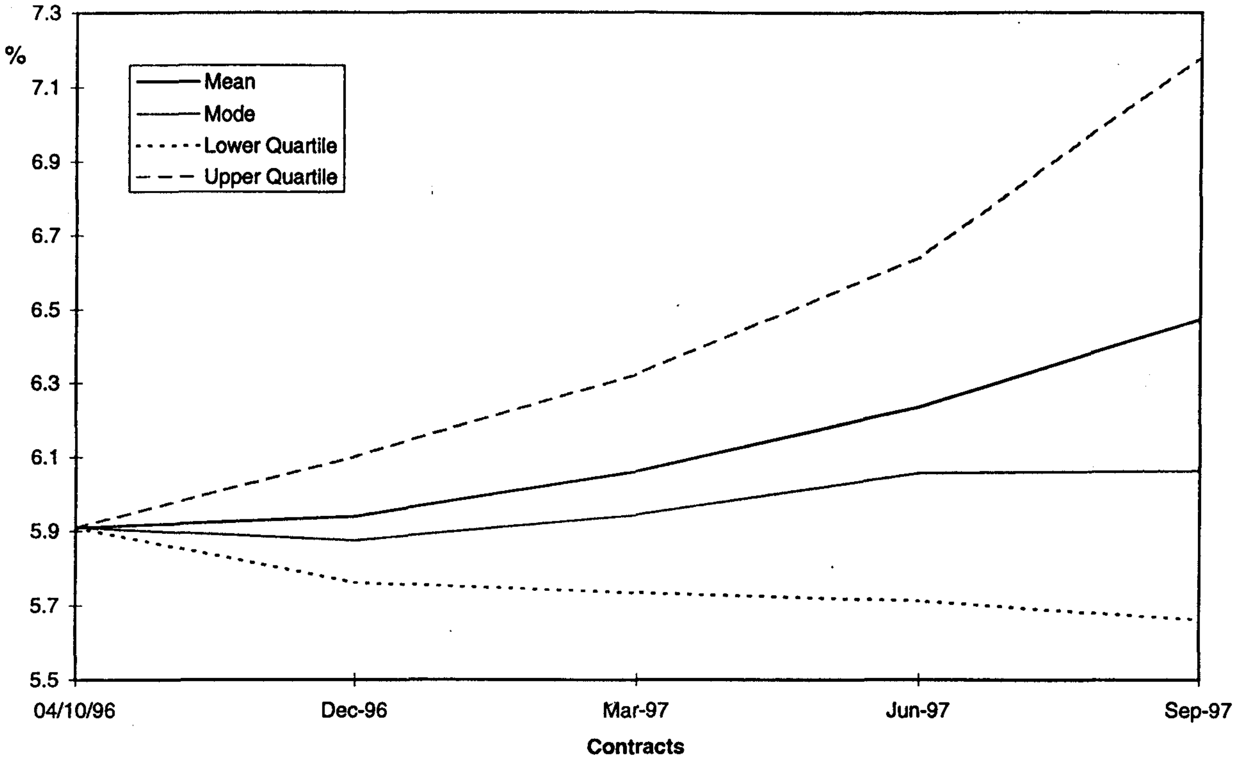


Chart 12

Three-month Deutsche mark interest rate as at 4th October 1996 and implied probability distribution summary statistics for future dates

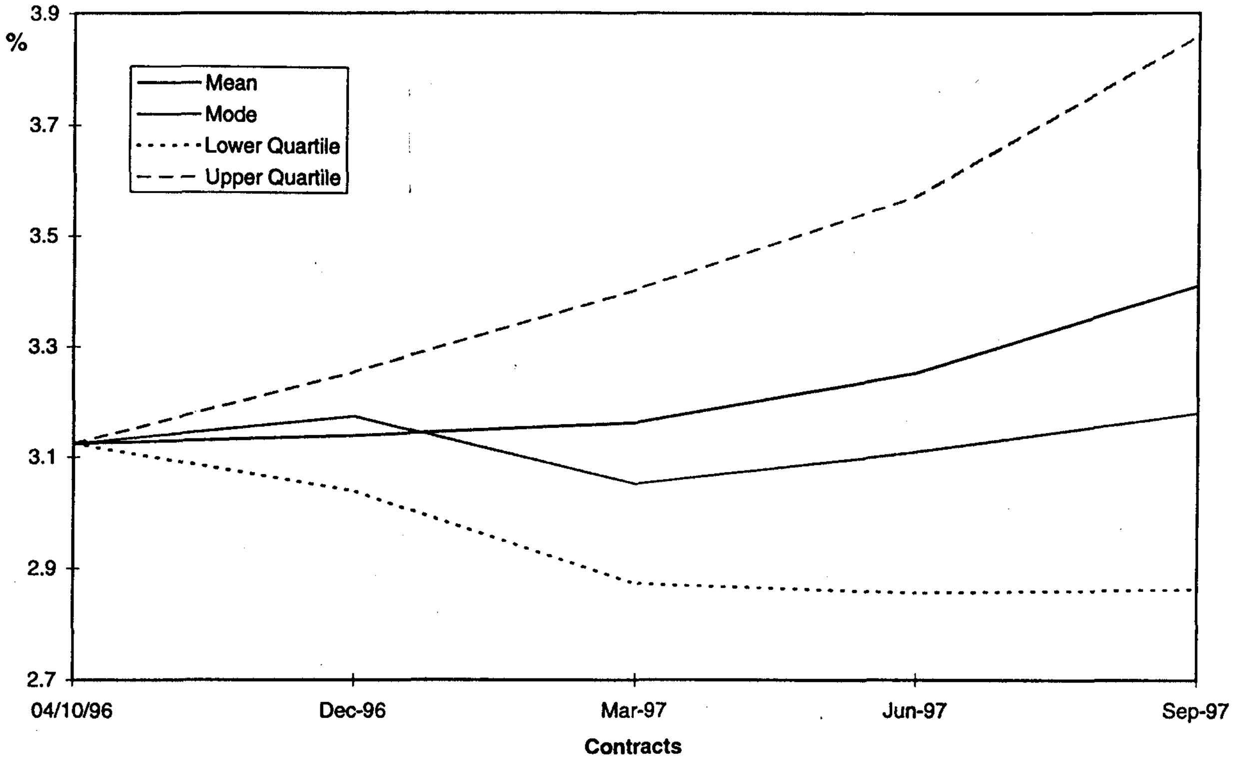
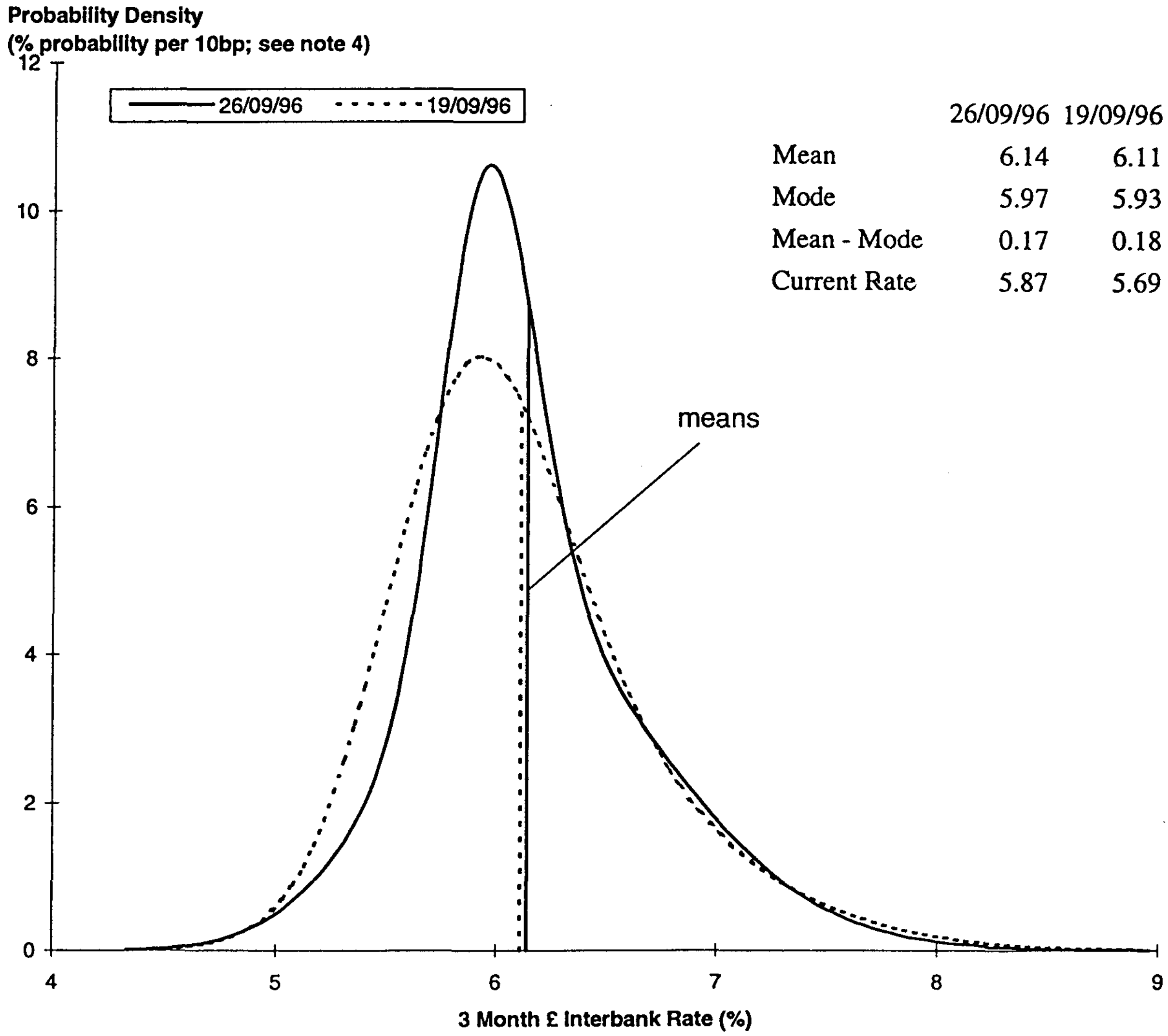


Chart 13
Sterling interest rate distribution for 19th March 1997 as at 19th and 26th September 1996



We are currently investigating the value added in, and reliability of, RND functions. One approach is to consider the *change* in probability of the three-month interbank rate being at or below the current level as a result of a particular event. Table 3 shows this change for the nearest and next but one contract dates for each of the past 46 monetary meetings (comparing the distribution at close of business on the day before the meeting with that at close of business on the day after the meeting). It illustrates how, on a number of occasions, there appears to be more "news" in the outcome of monetary meetings – including those where there is no change in official rates – when measured by this probability measure, than when measured by the accompanying change in the futures rate (equivalent to the mean value of the RND function). Estimated RND functions appear to be sensitive to the choice of optimisation routine, particularly for contracts close to expiry. So, until we have done further work on this and developed a confidence band for the derived distributions, this evidence of value added should be seen as tentative.

Table 3
Value added in implied probability distributions for three-month sterling interest rates

Meeting date	Nearest contract		Next nearest contract		Base rate
	Change in prob.* (%)	Change in mean (b.p.)	Change in prob.* (%)	Change in mean (b.p.)	Change (p.p.)
10/12/1992	3.12	2.00	-13.92	0.04	
13/01/1993	1.94	-17.65	5.09	-11.52	-1.00
03/02/1993	1.00	0.00	-0.10	-4.06	
03/03/1993	2.37	4.46	-16.83	-2.92	
07/04/1993	2.27	-4.97	11.24	-4.45	
06/05/1993	6.50	-10.14	19.40	-12.20	
09/06/1993	-5.98	1.07	-17.80	7.91	
27/07/1993	6.92	-20.85	16.41	-18.75	
08/09/1993	-4.25	4.02	10.90	10.07	
12/10/1993	8.07	-10.02	3.99	-14.01	
03/11/1993	2.32	-5.00	2.59	-6.86	-0.50
08/12/1993	0.73	-1.12	2.77	-3.03	
06/01/1994	6.35	-4.01	3.48	-6.99	
03/02/1994	-1.97	2.83	-5.15	5.96	-0.25
02/03/1994	0.62	-2.94	7.58	0.12	
30/03/1994	4.33	3.13	1.21	1.84	
04/05/1994	1.25	-0.18	-1.30	-1.03	
08/06/1994	0.63	-4.96	10.04	-0.99	
06/07/1994	-3.14	5.02	1.15	10.10	
28/07/1994	-0.90	45.92	-3.90	39.95	
07/09/1994	0.50	-14.08	1.80	-27.98	
26/09/1994	-0.12	0.00	-0.23	2.05	0.50
02/11/1994	0.12	-6.98	-0.13	-7.00	
07/12/1994	0.09	-2.92	-0.21	-9.10	
28/12/1994	-0.68	15.93	0.08	16.07	0.50
02/02/1995	-0.58	-1.90	-0.45	4.93	0.50
08/03/1995	0.30	-3.06	-1.51	-0.02	
05/04/1995	-1.18	-1.99	-1.26	-0.14	
05/05/1995	5.16	-16.19	16.25	-13.05	
07/06/1995	-7.59	0.02	9.13	10.01	
05/07/1995	3.24	-9.84	2.37	-12.60	
25/07/1995	5.26	-3.93	3.37	-10.00	
07/09/1995	2.53	-1.24	35.50	-1.80	
28/09/1995	9.47	-9.98	10.55	-18.57	
01/11/1995	2.13	-1.04	2.77	-1.19	
13/12/1995	4.58	0.93	9.12	-2.94	-0.25
17/01/1996	11.09	-18.99	12.92	-21.95	-0.25
07/02/1996	2.32	1.09	3.61	-4.12	
07/03/1996	-16.74	6.02	-1.76	22.96	-0.25
03/04/1996	-2.54	-0.95	2.53	1.85	
08/05/1996	-4.09	5.95	-12.74	1.86	
05/06/1996	26.20	-15.14	65.21	-20.86	-0.25
03/07/1996	1.21	-0.12	-4.01	-3.19	
31/07/1996	2.75	-2.05	-2.02	-2.00	
04/09/1996	-9.79	7.18	-43.47	7.97	
23/09/1996	1.58	6.04	-5.61	5.23	

* Probability of 3-month LIBOR on the maturity date of the option being less than the base rate prevailing on the day before the respective monetary meeting. (Change computed as the probability on the day after the meeting less the probability on the day before the meeting.)

We are currently investigating the value added in, and reliability of, RND functions. One approach is to consider the *change* in probability of the three-month interbank rate being at or below the current level as a result of a particular event. Table 3 shows this change for the nearest and next but one contract dates for each of the past 46 monetary meetings (comparing the distribution at close of business on the day before the meeting with that at close of business on the day after the meeting). It illustrates how, on a number of occasions, there appears to be more "news" in the outcome of monetary meetings – including those where there is no change in official rates – when measured by this probability measure, than when measured by the accompanying change in the futures rate (equivalent to the mean value of the RND function). Estimated RND functions appear to be sensitive to the choice of optimisation routine, particularly for contracts close to expiry. So, until we have done further work on this and developed a confidence band for the derived distributions, this evidence of value added should be seen as tentative.

Conclusion

This paper has described a number of developments that have already had an impact on UK money market operations over the past few years, and a number of issues that are likely to arise in the future, particularly as we take advantage of the development of the open gilt repo market and new financial instruments. It is clear that any system for setting official interest rates has to be ready to evolve in response to changes in market structure and changes in the framework in which monetary decisions are made.

Addendum

The Bank of England's operations in the sterling money markets: proposals for change

On 4th December 1996, the Bank of England published a consultative paper outlining proposals for changes in its daily money market operations. The key proposals were:

- **Gilt repo.** The Bank would extend its daily open market operations to include operations in gilt repo (repo of UK government bonds) alongside existing operations in Treasury bills and eligible local authority and bank bills;
- **Counterparties.** The Bank would broaden the range of counterparties able to participate in these operations, to include market participants active in the gilt repo and/or bill markets. Up to then, as the main paper explains, the main counterparties had been the specialist discount houses;
- **Late lending.** The Bank would also take the opportunity to simplify the arrangements for providing finance at the end of the trading day to adjust for any remaining imbalance in the market.

After a period of consultation, the Bank proposed to put the changes into effect in the early months of 1997, if possible.

The paper presented to the BIS meeting sets out the strains to which existing arrangements had been subject, and some of the advantages which operating in gilt repo might offer. By December the Bank judged that the new gilt repo market had indeed developed to the point where daily official gilt repo operations should be undertaken. In reaching this judgment the Bank took into account both the size of the market (already larger than the bill markets, and with the potential to grow further, given the stock of the underlying instrument – gilts) and the range of players active in the new market (wider than in the bill market, where the main settlement banks and the discount houses had predominated).

The proposed relationship with participants in the Bank's operations is seen as purely functional. The Bank will be prepared to deal with any supervised banks (including discount houses) building societies and securities firms which meet four functional criteria:

- they must have the technical capacity to respond quickly and efficiently in the Bank's operations;
- they must be active in the gilt repo and/or bill markets, thus contributing to the distribution of liquidity around the system (but there will be no formal market-making obligation);
- they will be expected to participate regularly in the operations;
- they will be expected to provide useful information to the Bank on market conditions and developments.

There will be no published list of those with whom the Bank has agreed to deal, and no need for counterparties to be separately capitalised. Nor will there be any special supervisory regime for counterparties as such. In all these ways the new arrangements will differ from existing arrangements for the discount houses. Until the new arrangements are in place the number of actual counterparties cannot be known. But the Bank intends that the business of being a counterparty should be fully contestable.

Gilt repo is a new form of secured money. By dealing in this market alongside the bill market the Bank intends to smooth the flow of liquidity to the market and the flow of eligible paper to the Bank. The wider availability of eligible paper and the wider range of counterparties make is less likely that operations will be dominated by a small number of institutions.

The Bank expects that its repo rate will become the "headline" UK official interest rate. Whenever it undertakes fixed rate repos, the Bank will state the rate in advance. (No rate is currently set in advance on days when the Bank is undertaking only outright operations.)

Some aspects of the Bank's operations will not change. There will be no reserve requirements (apart from the small Cash Ratio Deposits) and no averaging. The Bank will thus need to operate in the markets on most days. The average maturity of its current operations is about two weeks; in future it will generally offer three repos each day, at a maturity of two weeks and one working day shorter and longer than two weeks. In future, as now, only the settlement banks have a daily maintenance requirement at the central bank. In future only the settlement banks will have access to central bank funds late in the day to deal with unexpected liquidity developments (although there will be transitional arrangements available to the discount houses).

The Bank believes the proposed changes are consistent with the direction and spirit of the plans being drawn up in the EMI for monetary operations in euro. The emphasis on the use of repo in open market operations is clearly congruent with EMI plans. And the criteria proposed for participants in the Bank's operations are likely to resemble closely those proposed for the ECB in its choice of counterparties for high frequency ("fine-tuning") operations.

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Monetary policy instruments and procedures in Germany: evolution, deployment and effects

Peter Schmid and Henner Asche

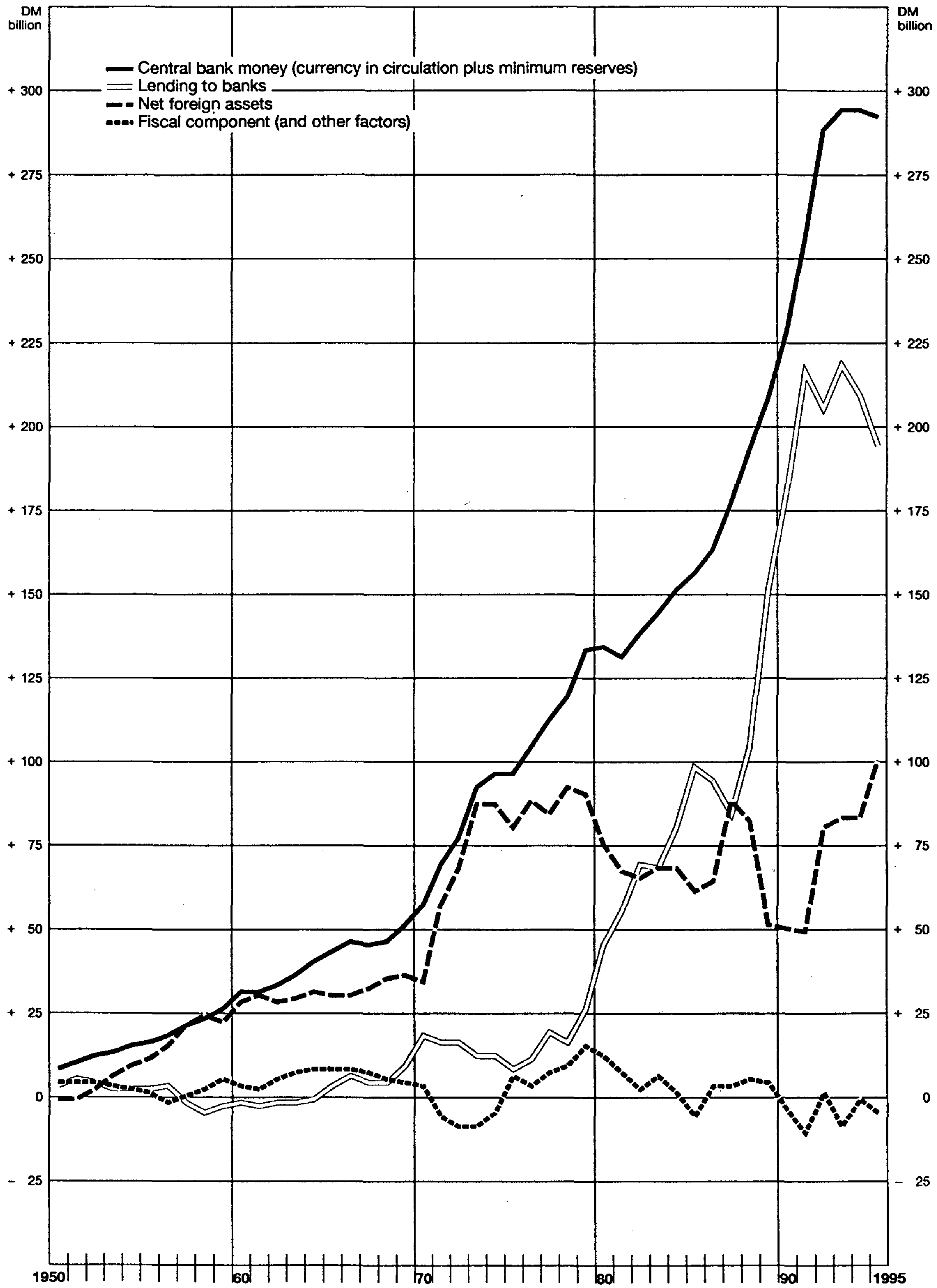
Introduction

Since the end of the Second World War money market policy in Germany has developed along comparatively steady lines. The set of monetary policy instruments with which the legislature provided the Bundesbank put the emphasis on bilateral refinancing relationships with the individual credit institutions in discount and lombard operations. It also, however, opened up the options of minimum reserve policy and open market policy. The statutory provisions left the Bundesbank sufficient scope for the actual application and further development of its instruments. It was even possible to come up with completely new instruments (for example, securities repurchase agreements, foreign exchange swaps) without amending the legal framework. Furthermore, the consistency of monetary policy was fostered by the progressive liberalisation of financial transactions (which had largely been completed by the end of the sixties) and by the special structural features and operating procedures of the German financial markets, particularly their high degree of competition and the prevailing long-termism.

Not even changes in the international monetary system entailed any radical changes in monetary policy practice. After the transition to floating exchange rates, the Bundesbank did alter its monetary policy strategy; with the abolition of obligatory intervention and the regaining of control over central bank money creation, it switched to monetary targeting in 1975. However, the transition to this "intermediate targeting strategy" had no direct consequences for the deployment of the monetary policy instruments. The switch to more flexible management of the money market, based increasingly on reversible open market operations, occurred gradually against the background of the growing interlinking of Germany as a financial centre with the international financial markets and the enhanced mobility of the investors of money and capital. The trend towards the globalisation of the financial markets, which particularly affects the Deutsche mark as the second most important international investment and reserve currency, called for a faster and phased response to changes in the global interest rate pattern and to expectations about future interest and exchange rate movements. Since 1985 the Bundesbank has been managing the money market predominantly by the revolving conclusion of open market transactions in securities under repurchase agreements (Chart 1). Since then there have been no more major innovations in the Bundesbank's arsenal of instruments. There have, however, been changes in the weighting and adjustments to the deployment of individual instruments so as to cope with the changing underlying conditions by recourse to these instruments.

The following sections initially outline the orientation and structure of the Bundesbank's monetary policy instruments. Subsequently, the principal changes in the use of these instruments during the past decade are described. There then follows a discussion of the "performance" of the current instruments at the money market level and in the downstream financial markets. In addition, the Bundesbank's current information policy and the use of market information in the Bundesbank's monetary policy practice are described.

Chart 1
Creation of central bank money: 1950-95
Annual averages



1. Orientation and structure of the monetary policy instruments

The Bundesbank's intervention options focus on instruments which influence the interest rate and the availability of funds in the money market in the direction of its monetary objectives, but leave the process of competition in the financial sector of the economy unaffected as far as possible. They are aimed indirectly at the banks' credit supply stance and at the demand for money and credit in the economy. To this end, the Bundesbank applies both interest rate and liquidity policy instruments; however, it is unable to limit the credit creation process in quantitative terms (credit ceilings) or to fix market interest rates administratively.[1]

The traditional interest rate policy instruments include the fixing of the discount rate and lombard rate, at which the Bundesbank, respectively, buys bills of exchange from banks (for not more than three months) and grants them, in general, very short-dated loans against the collateral of securities (Table 1). The Bundesbank Act does not lay down any upper or lower limits for these interest rates, but discount credit has always been the cheapest and lombard loans the most expensive source of refinancing, with the result that both are assigned the function of "key interest rates". Whereas the comparatively low discount rate contains an element of subsidy, the size of which depends on the difference between that rate and the other central bank and market interest rates, the lombard rate is above the short-term market interest rates and has, rather, the character of a marginal lending rate. Moreover, during the past decade the repo rate has assumed the status of a third "key interest rate", which is managed by the Bundesbank within the interest rate corridor marked out by the discount and lombard rates, and which determines the course of the day-to-day money rate (Chart 2).

Table 1
Instruments of monetary policy in Germany

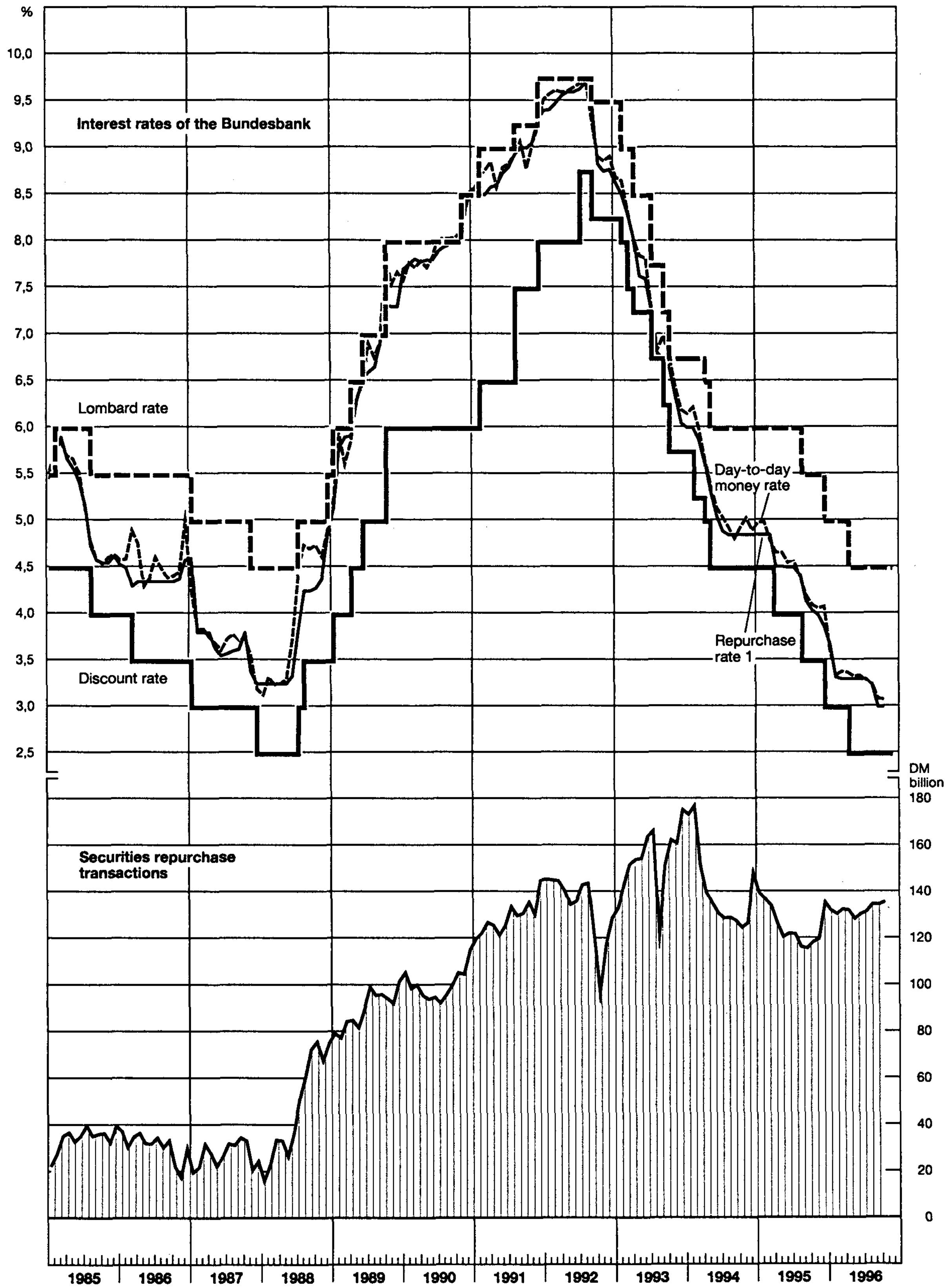
Longer-run adjustments	Fine-tuning measures
Interest rate policy	
Discount rate	Repo rate
Lombard rate	Treasury bill selling rate*
Bank liquidity	
Minimum reserves	Short-term liquidity Treasury bill sales
Rediscount quotas	Foreign exchange repurchase agreements
Outright operations in long-term bonds	Foreign exchange swaps
Issue and redemption of Bundesbank "liquidity paper"	Quick tenders
	Deposit policy (up to 1994)
Securities repurchase agreements (repos)	

* Selling rate set for bill-type short-term Bundesbank "liquidity paper" acts as a floor for the day-to-day money rate.

[1] For a detailed description of the Bundesbank's current instruments, see Deutsche Bundesbank (1995b).

Chart 2

Operating variables in the money market



1 Average monthly interest rate for securities repurchase transactions with one-month maturities and, from October 1992, with two-week maturities; uniform allotment rate (fixed-rate tenders) or marginal allotment rate (variable-rate tenders).

Besides changes in minimum reserve requirements, the traditional instruments of liquidity policy in Germany include the possibility of limiting qualitative and quantitative access to discount credit and lombard loans. Today open market policy, in the form of securities repurchase transactions, constitutes the most important liquidity policy operational parameter. Open market policy in the widest sense also includes foreign exchange swap and repurchase transactions, as well as shifts of Federal balances into the money market (up to 1994), which have been used only sporadically, if at all.

The traditional instruments have tended to be used for longer-term adjustment purposes: they either set longer-term benchmarks for price formation in the financial markets, or serve to meet the banks' central bank money requirements over the longer term or to contain their liquidity scope. By contrast, open market policy fine-tuning measures serve mainly to offset temporary fluctuations in bank liquidity and to steer money market rates as unobtrusively as possible in the desired direction. The Bundesbank's repo transactions cannot be classified unambiguously under these headings; they are of a dual nature, as they serve both permanent refinancing and the fine-tuning of bank liquidity.

2. Changes in operating procedures over the last decade

In the past few years, the Bundesbank has increasingly taken account of market economy principles, and particularly of the criterion of competitive neutrality, in shaping its instruments. In the light of regulatory considerations, but also against the backdrop of the growing globalisation of the financial markets, it has reduced differentiating and discriminating regulations and given greater weight to instruments consistent with market conditions. This is illustrated particularly clearly by the restructuring of the minimum reserves and the change in the significance of rediscount policy, as well as by the improvement and refinement of the open market policy instruments (see also Table 2).

Table 2
Bundesbank balance sheet structure*
In percentages

Assets		Liabilities	
June 1985			
Net foreign assets	34.3	Banknotes	58.4
Lending to government	1.4	Required reserve deposits	28.2
Discount lending	38.2	Deposits of domestic non-banks (incl. government deposits)	3.1
Marginal lending	0.3		
Repos	21.1		
Securities held outright	2.2		
Float	2.5	Balancing item	10.3
Total	100.0	Total	100.0
June 1996			
Net foreign assets	35.5	Banknotes	81.5
		Required reserve deposits	13.0
Discount lending	21.1	Deposits of domestic non-banks (incl. government deposits)	0.2
Marginal lending	0.1		
Repos	43.3	Float	0.7
		Balancing item	4.6
Total	100.0	Total	100.0

* Calculated on the basis of daily averages of the months.

2.1 Restructuring of the minimum reserves

The monetary policy substance of the minimum reserves has changed over time, without the Bundesbank's basic attitude to this instrument having altered. Today, however, the monetary policy significance of the minimum reserves is seen less in their function as an "inhibitor of money creation" than in their function of ensuring a lasting demand for central bank money, a stable demand for central bank balances and of acting as a liquidity buffer in the money market. In order to ensure the efficiency of monetary policy, i.e. the central bank's interest rate leadership in the money market, the banking system must be kept sufficiently dependent on central bank refinancing. As a glance at the structure of the Bundesbank's balance sheet shows, at present this does not necessitate any minimum reserve requirements owing to the large amount of banknotes in circulation, but the future trend of currency in circulation is difficult to assess against the background of the increased advance of cashless payment media. The minimum reserve instrument enables the Bundesbank to adjust the size of the lasting demand for central bank money by varying the reserve ratios. As an instrument of economic management to offset fairly sharp fluctuations in liquidity, the Bundesbank last used the minimum reserves at the beginning of 1987 to absorb heavy foreign exchange inflows. For this purpose it now has a more flexible alternative available, in the shape of securities repurchase transactions.

Today the minimum reserves are used solely for regulatory purposes, as they mark out the framework for the deployment of the remaining monetary policy instruments. At the same time, they were restructured in three steps between 1993 and 1995, with the aim of reducing the incentives to circumvent them and of adjusting the instrument to liberalised and globalised financial markets. The Euro-markets, in particular, where the banks do not incur any minimum reserve costs, offer an interest rate advantage that is relevant to investment decisions. This competitive disadvantage of the financial centre in Germany fostered cash-holding outside Germany and impaired the informative value of the domestic monetary aggregates. Against this background the reserve regulations were simplified,[2] and the reserve ratios for the individual categories of deposit were largely brought into line with one another and lowered considerably (see Chart 3).[3] This led to considerable cost relief for the banks.[4] The Bundesbank extended the restructuring of the minimum reserves over a fairly long period in order to preserve the stability of the demand for central bank money, and not to jeopardise the cushioning function of the minimum reserves in the money market.
These are maintained as long as the reserve requirements exceed the working balances held on a voluntary basis by a sufficiently wide margin. This could always be assumed, since the banks' working balances (the exact amount of which cannot be measured) have likewise decreased sharply in the recent past. On the one hand, the credit institutions have increased their central bank liquidity holdings; on the other, the volatility of bank liquidity, and thus the necessity to hold precautionary balances, have been reduced by several institutional and technical changes. These included the abolition of the deposit requirement for the Federal Government at the beginning of 1994[5] (decided in connection with the entry into force of the second stage of European economic and monetary union) and the changes in the Bundesbank's payment operations with the aim of exploiting the technical

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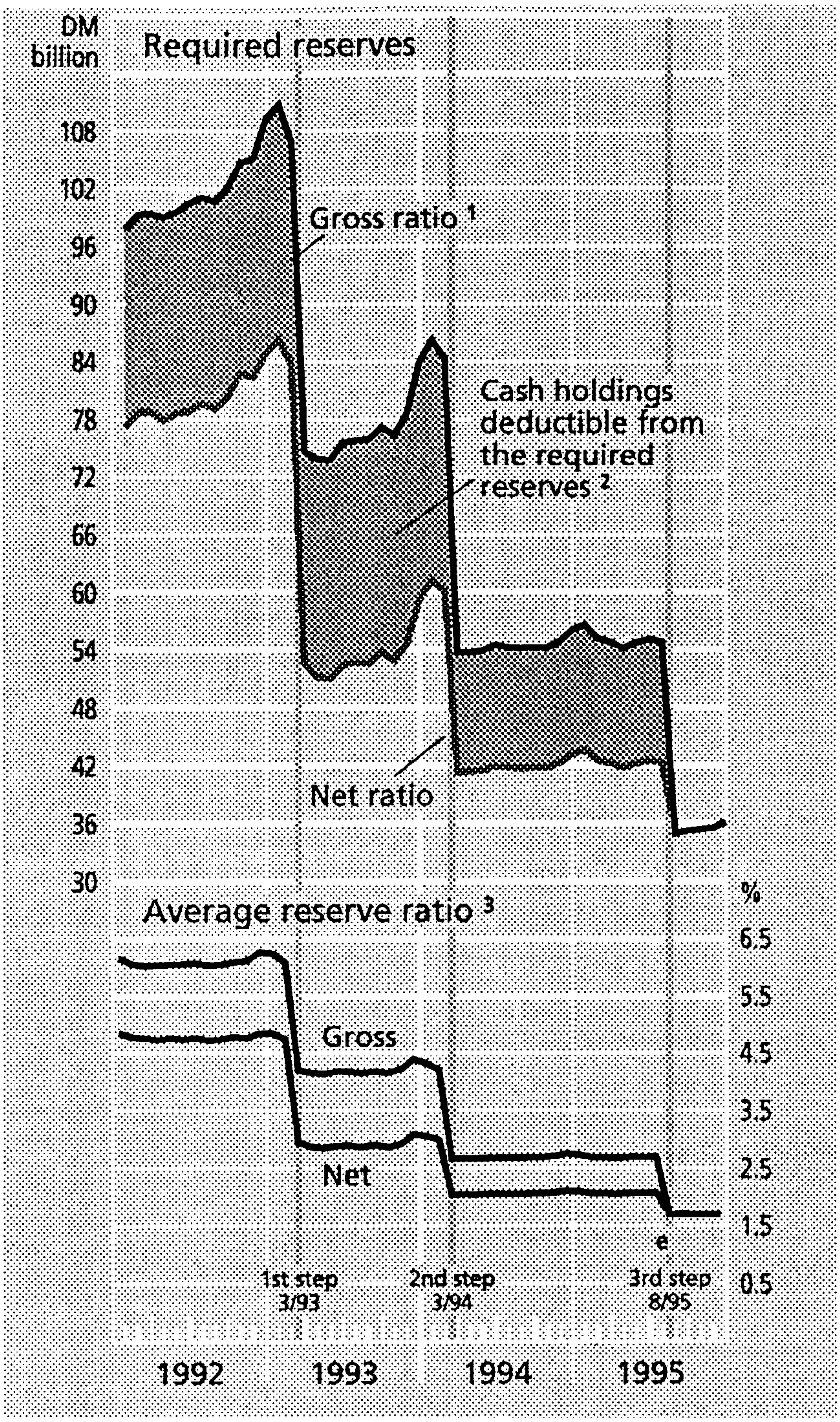
2 The progressive reserve stages for sight liabilities were abolished (for time and savings deposits as early as 1986), as were the differentiation of reserve ratios for liabilities to, respectively, residents and non-residents, as well as the deductibility of the credit institutions' cash holdings from minimum reserve requirements.

3 For the measures in detail, see Deutsche Bundesbank (1994b) and (1995a).

4 When assessing the cost of the minimum reserves, the subsidised refinancing via rediscount credit must be taken into account, along with the fact that the minimum reserve balances can also be used as working balances.

5 For details, see Deutsche Bundesbank (1994a).

Chart 3
Restructuring of the minimum reserves
Monthly figures



[1] Required reserves before the deduction of cash holdings. [2] Until February 1994 limited to 50% of the required reserves, from March 1994 to July 1995 limited to 25%; from August 1995 no longer deductible. [3] Gross or net ratio in relation to the liabilities subject to reserve requirements. [e] July-August 1995 position estimated on the basis of the figures for June.

Source: Deutsche Bundesbank.

options for reducing the maturity-related float.[6] At the end of 1994, the large-value cheque collection procedure was implemented in the Bundesbank system, and in July 1995 it was extended.[7] In the upshot, the difference between credit institutions' reserve balances and their working balances narrowed distinctly. The pattern of compliance with reserve requirements in the course of the month has changed significantly for that reason, and because of the smaller fluctuations in bank liquidity (see Chart 4). Until the beginning of the nineties, quite considerable "advance compliance" with the minimum reserve requirements was typical of the pattern, and such compliance dwindled rapidly with liquidity withdrawals on the tax payment dates, settling down at the usual marginal compliance with the reserve requirements towards the end of the month. Nowadays, in contrast, the inflows and outflows of public funds are no longer reflected in pronounced fluctuations in the banks' central bank balances, but cancel out in the money market, with the result that the central bank balances fluctuate more closely around the required reserves. The aforementioned innovations in the Bundesbank's payment operations, which reduced the level and margin of fluctuation of the float, operated in the same direction. The (net) required reserves have decreased from around DM 47 billion in 1985 via almost DM 87 billion at the beginning of 1993 and to currently DM 37½ billion, and the amplitudes of central bank balances in the course of a month have declined from peaks of around DM 30 billion in 1992 to about DM 5 to 8 billion at present.

The Bundesbank has adjusted its money market management to this new compliance pattern aimed at by the banks, which is as uniform as possible. If it wishes to keep the money market in balance, it tries to gauge its provision of funds in such a way that the difference between the daily central bank balances of credit institutions and the required reserves remains as low and as free from fluctuations as possible during the entire month. In order to put this area of tolerance into operation, the Bundesbank has developed, on the basis of past experience, what is known as a reserve management band. Overshootings of the band indicate an easing of interest rate conditions in the day-to-day money market, while undershootings provoke tensions. The amount of the required reserves is not known at the beginning of a month. The necessary estimate is initially based, in principle, on normative sorts of assumptions, which are derived from a rate of monetary expansion compatible with the current monetary target. (The change in currency in circulation is forecast in the same way at the beginning of a month.) In this way, the liquidity provision in the money market is quantitatively linked with the monetary target. The estimate is not updated until the second half of the month, in keeping with the inflow of information on the actual trend, and then loses its purely normative character.

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6 According to Section 3 of the Bundesbank Act, the Bundesbank has to arrange for the execution of domestic and international payments. It fulfils this duty by making available to the credit institutions of the various bank categories (which each maintain their own giro networks) a payment system not affecting competition. By means of its own terms and conditions, its terms for debits and credits and its prices, it influences the extent to which the credit institutions use the Bundesbank network. Against the background of the close interrelationship between the implementation of monetary policy and the settlement of payments through the central banks, the Bundesbank fosters in particular large-value payment transactions, for the use of the monetary policy instruments presupposes an efficient and safe large-value payment system through which liquid funds can be made available to the money market and possibly turned over several times a day. Of paramount importance are the express electronic intercity and local credit transfer system (gross settlement procedure) and the electronic clearing in Frankfurt am Main (which combines elements of a gross settlement system with elements of a liquidity-saving net settlement system).

7 For details of the trends in the bundesbank's cashless payments since the middle of the eighties, see Deutsche Bundesbank (1994d). With the large-value cheque collection procedure, the introduction of large-value cheques into supraregional collections has been accelerated; the collection period new corresponds to the Bundesbank's terms for credits. As early as 1991 the Bundesbank had taken comprehensive measures to reduce, in particular, the positive float in payments with public cash offices.

Chart 4
Pattern of minimum reserve compliance

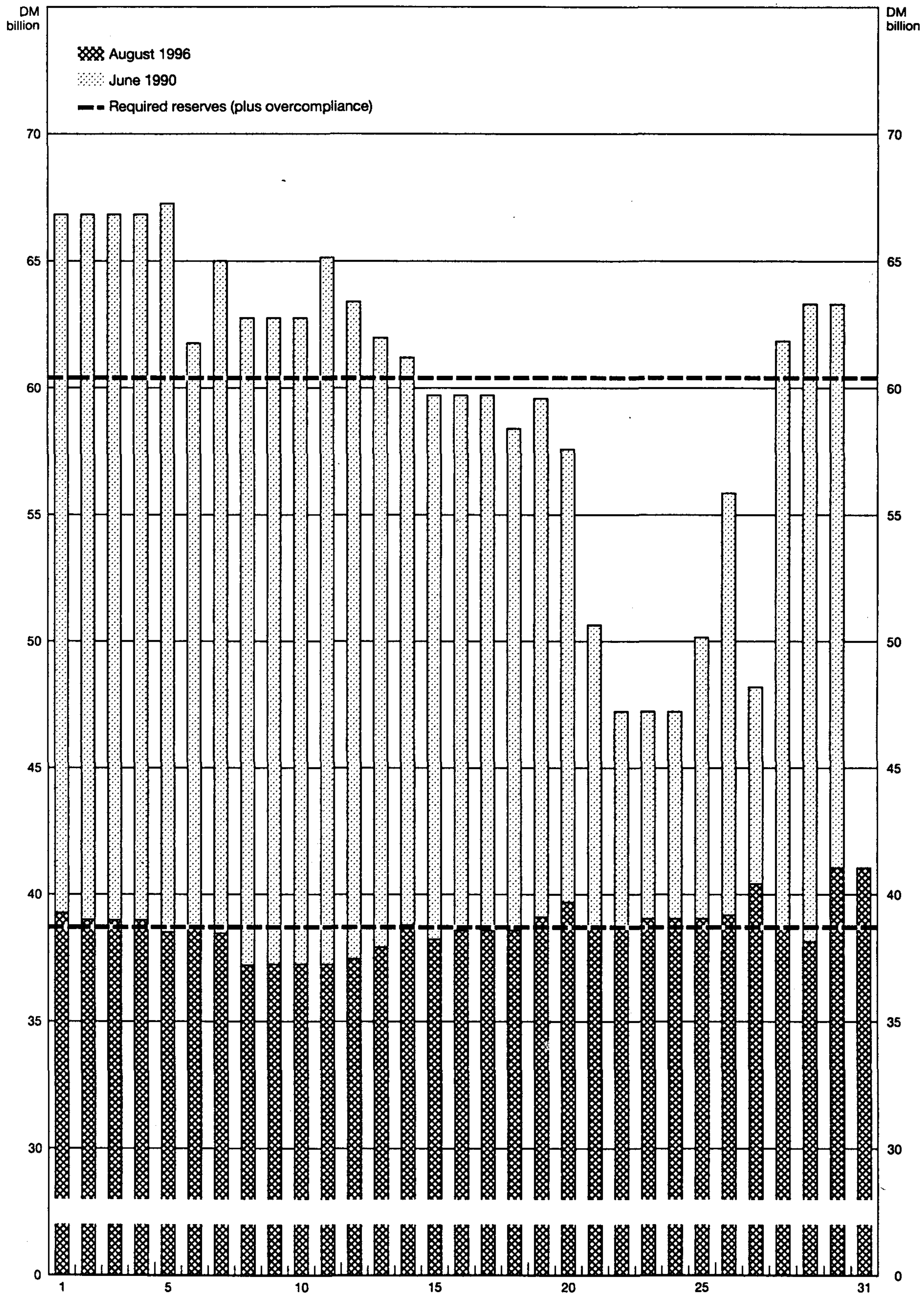
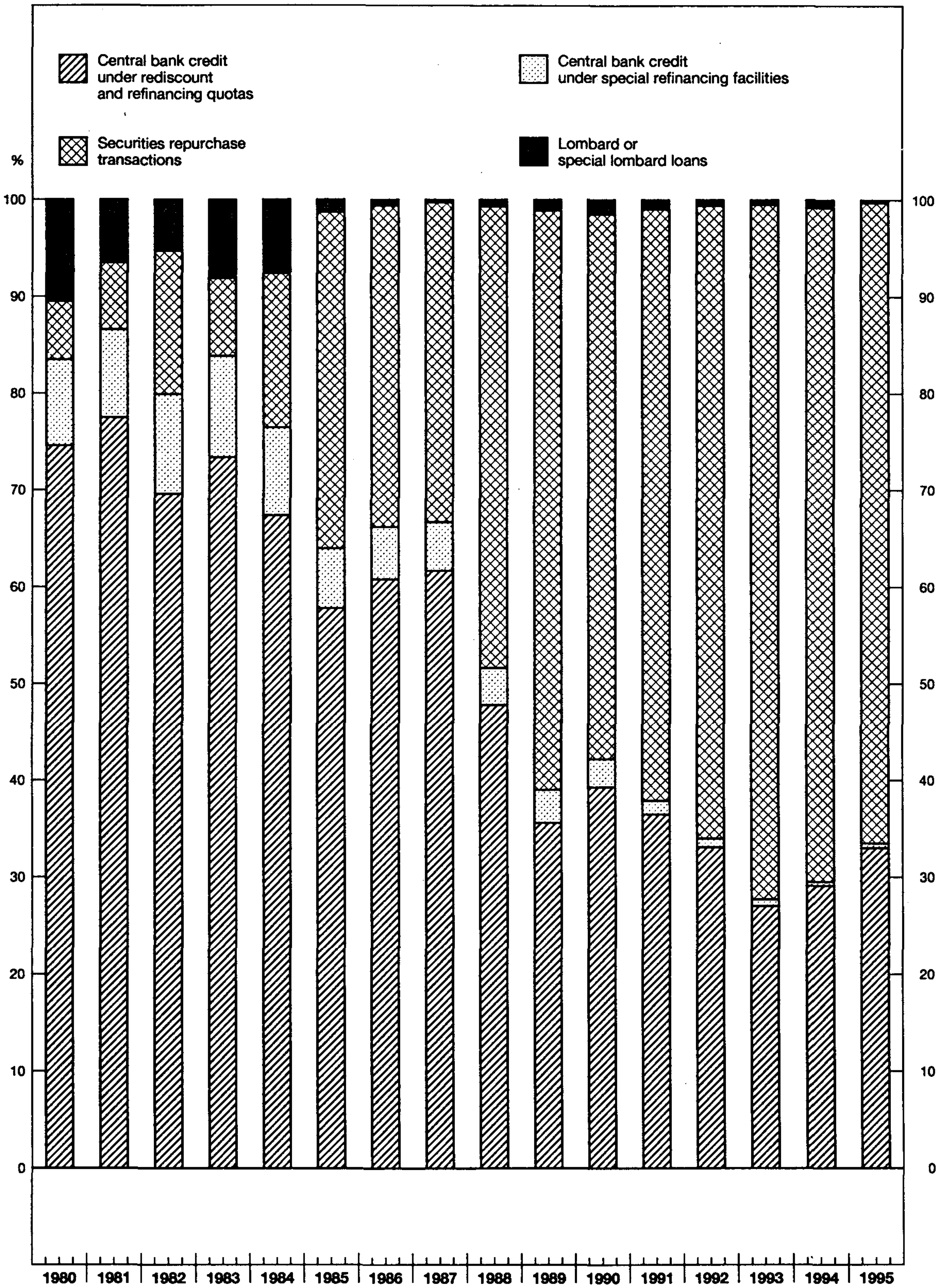


Chart 5

Pattern of credit institutions' borrowing from the Bundesbank*

Percentage share of total funding (based on monthly average amounts)



* Excluding open market operations in trade bills under repurchase agreements, foreign exchange swap and repurchase transactions, shifts of Federal balances under section 17 of the Bundesbank Act and quick tenders.

2.2 Dwindling significance of rediscount policy

The Bundesbank still sees the purchase of trade bills as being a reasonable means of providing longer-term central bank money, since this is a flexible basic refinancing facility of the banking system and the economy. Nevertheless, the quantitative significance of rediscount credit has decreased substantially. The subsidy character of the discount rate calls for a quota system for the rediscount volume; the fixing of quotas for individual banks means that infringements of the principle of competitive neutrality can hardly be avoided. In the past few years the Bundesbank has therefore successively reduced the "special refinancing facilities" which existed alongside the normal rediscount quotas (of DM 65½ billion), and which were intended to cater for special financing needs (from about DM 7 billion in 1985 to barely DM 1 billion in 1996). Such monetary policy regulations, which tended to have a selective effect, served to promote exports, small and medium-sized firms and trade between the Federal Republic of Germany and the German Democratic Republic.

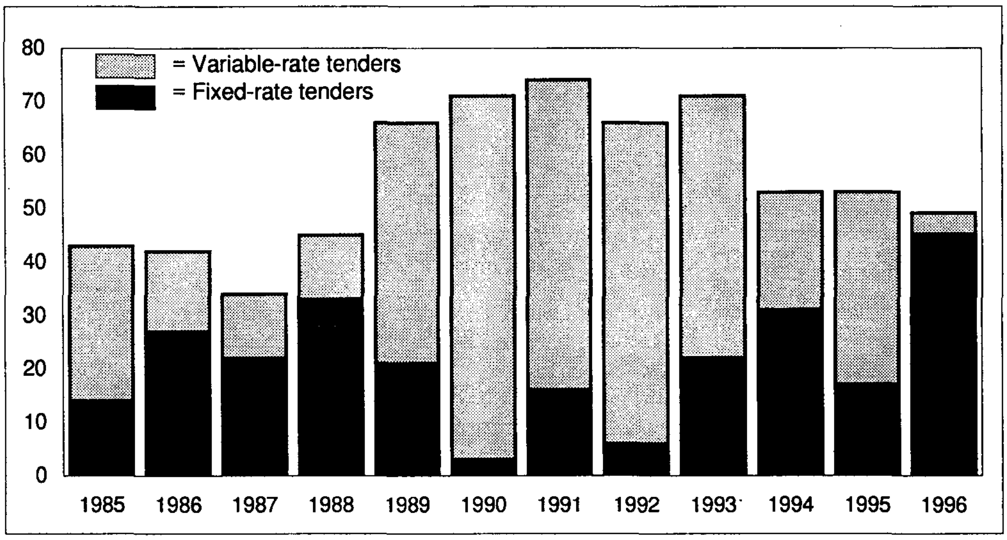
The share of bill-based lending in credit institutions' overall refinancing at the Bundesbank has been reduced almost continuously from two-thirds to one-third during the past decade (see Chart 5). Bill rediscounting has thus only performed the function of basic refinancing for some time now. It increased in significance for a time at the beginning of the nineties, in connection with intra-German monetary union. In the middle of the present decade its share again rose slightly, when the sizeable release of funds in the wake of the restructuring of the minimum reserves was only offset by a reduction in repos. The absolute size of the total amount of normal rediscount quotas has hardly changed since 1992, and is currently back at the level of the end of 1989. Rediscount policy is no longer being used as an instrument for managing liquidity.

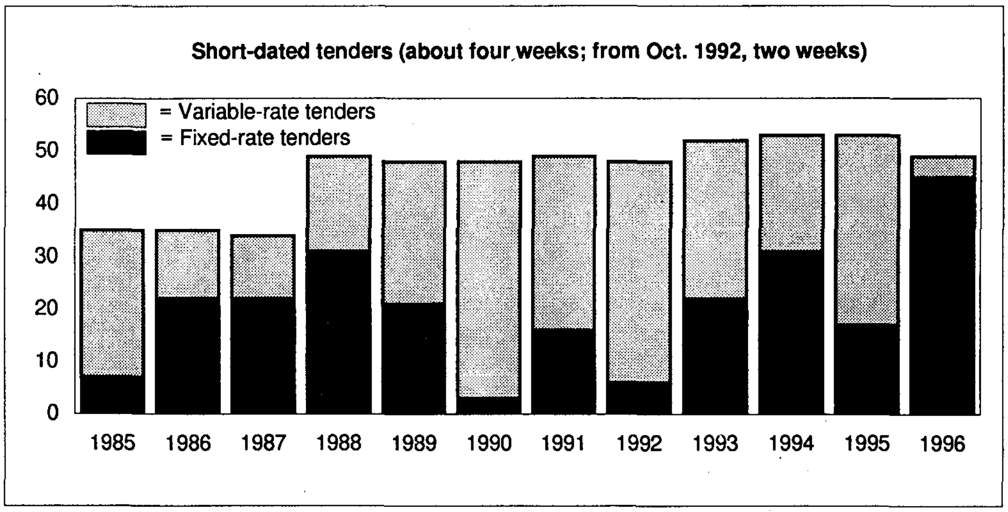
2.3 Extension of open market policy

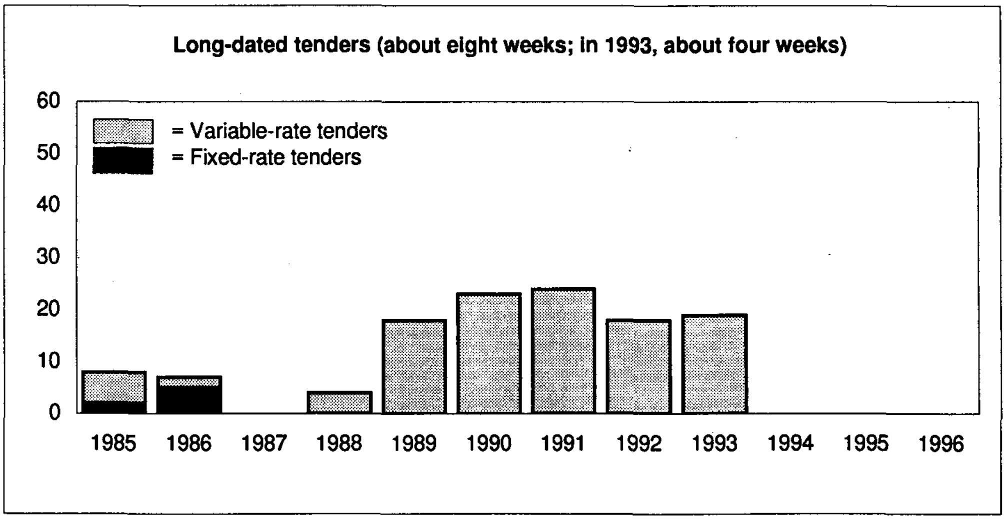
Forgoing the use of minimum reserve and rediscount policy for economic management implied a shift of emphasis in favour of open market policy; meanwhile, it has become the key determinant of the banks' overall refinancing.

Open market policy in Germany is conducted almost entirely through the instrument of securities repurchase transactions, i.e. purchases of securities for a limited period. The traditional form of open market policy, namely the definitive purchase and sale of long-term securities (permissible by law only for the purpose of regulating the money market) has always been pursued by the Bundesbank only sporadically, among other things in order not to arouse the wrong impression that interest rate movements in the bond market are a reflection of its operations in that market (see Table 2). Open market operations in money market paper are likewise of only rudimentary significance. One reason for this is that, virtually up to the present, there has been only a rather narrow market in Germany for private and public money market paper, in which the central bank could act by means of its traditional open market policy. The development of such a market was hindered both by the traditional bilateral refinancing operations of the banks with the Bundesbank and by the minimum reserve system, as well as by the aversion to short-termism in financial relations, and the predominance of the universal banking system. The money market paper currently being used by the Bundesbank comes into being at the initiative of the Bundesbank itself. It is entitled to circulate Federal Treasury bills in the form of liquidity paper (since 1992, up to a maximum amount of DM 50 billion). However, it may sell liquidity paper, if necessary, only at short term – for three days as a rule – to mop up temporary excess liquidity in the money market. (Such paper is also sold to non-residents on a small scale.) In addition, such paper was tendered in the open market for a while (from spring 1993 to the autumn of 1994) in the form of Bundesbank Treasury liquidity discount paper (Bulis) with maturities of several months. On the one hand, these auctions served to offset, in liquidity terms, the heavy minimum reserve reduction at the time; on the other, the Bundesbank tried to influence the cash holdings of domestic non-banks directly. Since the latter attempt did not succeed – the Bulis were bought primarily by non-residents – the Buli auctions were discontinued.

Chart 6
Securities repurchase transactions of the Bundesbank*







* 1996: January-November.

Given the ruling conditions of the financial system, it seemed appropriate to the Bundesbank to take advantage of German banks' large holdings of fixed-income securities to engage in open market policy in the form of repurchase transactions (repos). In the past decade repos have not only expanded sharply in terms of volume, their technical design has also been refined. In August 1988 the frequency of repos was increased from three per month (since February 1985) to four; since December 1993 one repo has been offered every week. From July 1989 to October 1992 repos were almost always offered with two different maturities (for one month and for two months); subsequently, against the background of the EMS crisis, the maturities of the transactions were reduced to two and four weeks; as a result (other things being equal), the settlement volume per repo, and thus the Bundesbank's liquidity policy scope, increased distinctly. Since the end of 1993 only two-week repurchase transactions have been offered. In November 1988 the Bundesbank supplemented its range of instruments by adding the so-called "quick tender", by means of which the money market can be managed flexibly from day to day outside the regular repo pattern. The Bundesbank offers repos in the shape of fixed-rate tenders and variable-rate tenders. In the autumn of 1988 it changed the variable-rate tender from the Dutch-style to the US-style auction, and refrained from specifying a minimum bidding rate. In this way, market tendencies gained greater influence over interest rate formation. Moreover, since banks have been able, since the end of 1992, to submit bids for full 0.01 percentage points (instead of 0.05 percentage points, as previously), coordinated bidding behaviour on the part of credit institutions is made more difficult, and the signal effects of interest rate changes tend to be mitigated.

The variable-rate tender is often regarded as conforming better with market conditions since it enables banks to influence interest rate formation. In practice, however, the Bundesbank has frequently resorted to the fixed-rate tender when it wished to steady interest rate movements or to provide the market with clear interest rate signals. Historically, the fixed-rate tender predominated in the period of falling interest rates from 1985 to 1988, whereas variable-rate tenders were mostly offered in the subsequent period of rising interest rates until 1992. The ensuing period of easing interest rates was accompanied by the more frequent use of fixed-rate tenders (see Chart 6). The high price volatilities in the financial markets were a major factor in this. In such periods the Bundesbank tends to guide the market by pursuing an interest rate policy of "steady as she goes" (see Section 3.2 below).

3. Performance of the instruments

Monetary policy in Germany is based on comparatively stable financial market structures and transmission mechanisms in the financial sector, which can be traced back not least to the steady evolution of this sector and the great weight of universal banks in the German financial markets. The large number of banks with direct access to central bank credit[8] and the relatively keen competition among banks foster the rapid transfer of monetary policy stimuli via changes in market interest rates. The longer end of the term structure is increasingly being affected by expectations in the global financial markets; the desired steadying of longer-term expectations is, in turn, highly dependent on the degree of consistency of the monetary policy measures. Inconsistency, and also lack of transparency, trigger sanctions on the part of the markets, which cannot be countered by instrumental operations alone.

Against this background, the performance of the Bundesbank's instruments must be measured in terms of the extent to which they succeed in achieving the operational targets set at the money market level (i.e. the control of bank liquidity and of short-term money market rates) and in

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[8] Of the approximately 3,500 credit institutions in Germany, over 2,500 have an autonomous rediscount quota and hold securities in operational safe custody accounts with the Bundesbank to collateralise lombard loans and to participate in repos.

influencing conditions in the downstream financial markets – which help to determine the monetary expansion process – in line with the target. Basically, the operational targets should not be defined too narrowly, so that compliance with them can be guaranteed with the existing set of instruments, duly adjusted to cope with any possible shocks, and their flexible deployment – even in an environment which is tending to be more volatile as a result of the internationalisation of the financial markets.[9]

3.1 Management of the day-to-day money rate

The level of the day-to-day money rate, i.e. the market price of credit institutions' reserve balances, is geared to the repo rate and its margin of fluctuation is limited by the interest rate corridor set by the Bundesbank, with its ceiling fixed by the lombard rate and its floor (if appropriate) by the price of short-term Treasury bills (liquidity paper; not a standing facility). The volatility of the day-to-day money rate within the interest rate band depends on:

- the volatility of the market factors determining bank liquidity (currency in circulation, foreign exchange movements, float);
- the interest rate elasticity of the demand for central bank balances; and
- the liquidity-adjusting operations of the Bundesbank.

Other things being equal, the changes in the past few years described in Section 2 have tended to help to reduce the volatility of the day-to-day money rate: upon the exemption of public cash offices from deposit requirements in 1994, the most volatile determinant of liquidity up to then, ceased to be operative. The innovations in the Bundesbank's payment system have reduced the amplitude of the float in the course of a month from up to DM 20 billion at the end of 1990 (equal to 30% of the net required reserves) to currently not more than DM 4 billion (equal to 10% of the required reserves). At the same time, the demand for central bank money during the month – except in the last few trading days of the reserve compliance period – remained responsive enough to interest rate changes to absorb liquidity shocks almost unobtrusively; in other words, the averaging provisions of the minimum reserves remained effective, despite the sizeable reductions in the reserve ratios. Finally, the fine-tuning instruments satisfied the requirement of being able to manage the provision of the banking system with liquidity in line with the target. Even in extreme situations (the intra-German monetary union in 1990, the EMS crises in 1992 and 1993, profit distributions by the Bundesbank) they proved to be efficient.[10]

As a rule, however (i.e. in periods without exceptional burdens), the major part of the daily liquidity shocks is absorbed by the minimum reserve balances alone; that is to say, without intervention by the Bundesbank.[11] Open market operations, here primarily the repos, which are offered once a week, mainly have the task of keeping the reserve balances within a narrow range around the required reserves. Very short-term assistance operations (quick tenders, foreign exchange swaps, Treasury bill sales)[12] are therefore very rarely required, and are chiefly deployed towards the end of the compliance period. In the recent past hardly any recourse to them has been necessary.

A glance at the movement of the day-to-day money rate shows that during the past decade, its fluctuations (as measured in terms of the relative change from the previous day) have

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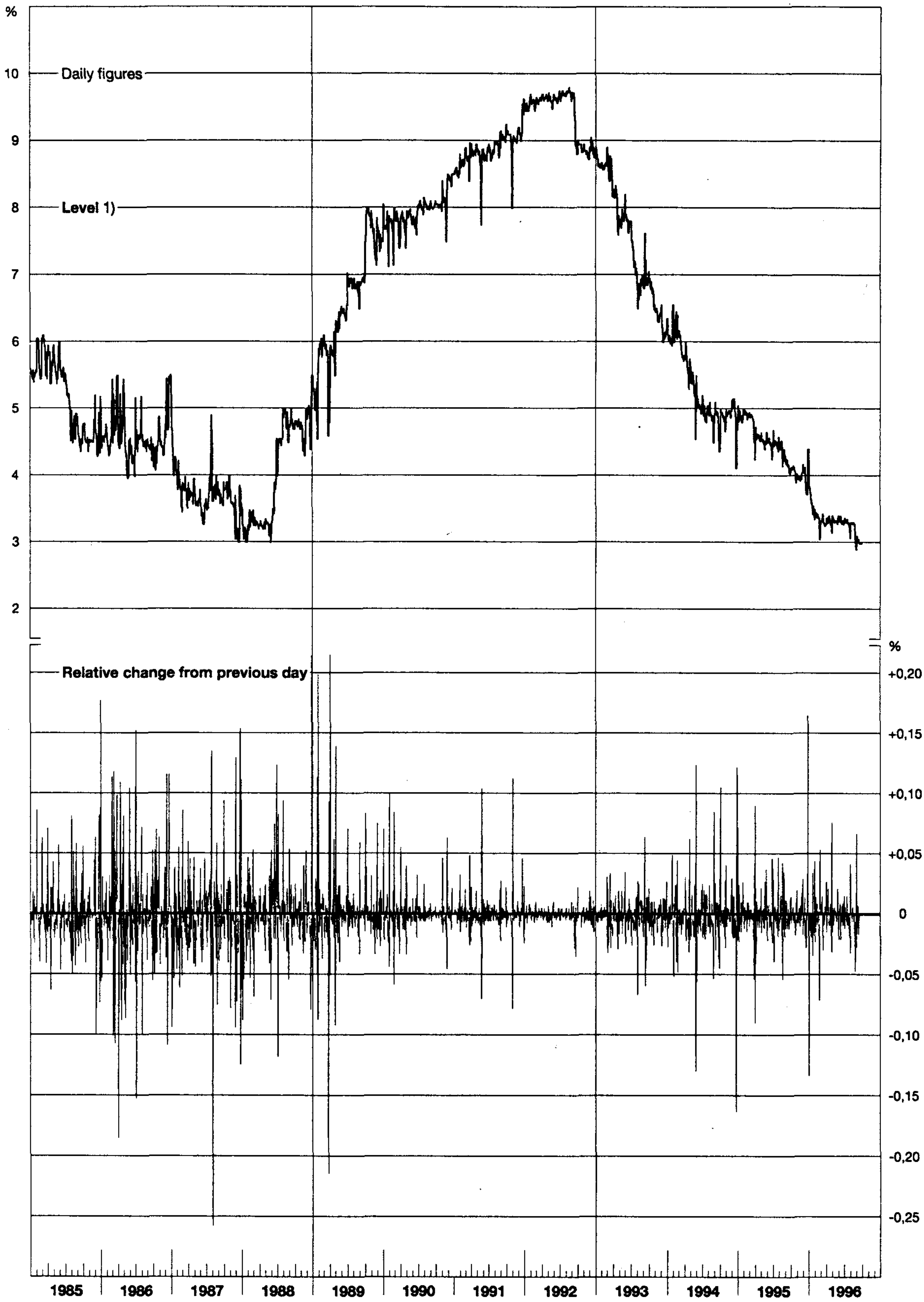
9 See also Bisignano (1996).

10 See Deutsche Bundesbank (1994c).

11 For Germany this is again confirmed by a recent international comparison, according to which an estimated two-thirds of the daily shocks is absorbed by the minimum reserves. Escrivá and Fagan (1996).

12 The very short-term fine-tuning instrument most used over many years, i.e. the day-to-day shifting of Federal funds into the money market, has not been available to the Bundesbank since 1994.

Chart 7
Day-to-day money rate
Level and relative change from previous day



1) Adjusted for changes at the end-of-month.

Table 3
Statistical measures of money market volatility*
In percentages and percentage points

	Average volatility (% p.a.)	Maximum volatility (% p.a.)	Maximum relative rise (% from previous day)	Maximum relative decline (% from previous day)	Maximum absolute rise (% points from previous day)	Maximum absolute decline (% points from previous day)
Day-to-day money rate						
Start-1985 to end-1989......	42.68					
Start-1990 to August 1996	20.03					
Period of falling interest rates, 1985 to 1988...........	43.76	96.55	17.70	-25.70	0.84	-1.06
Period of rising interest rates, 1988 to 1992...........	23.92	90.94	21.50	-21.40	1.15	-1.10
Period of falling interest rates since 1992	23.53	73.42	16.50	-16.30	0.67	-0.73
Interest rate for three-month funds						
Start-1985 to end-1989......	10.92					
Start-1990 to August 1996	5.44					
Period of falling interest rates, 1985 to 1988...........	10.62	52.81	11.80	-7.70	0.50	-0.33
Period of rising interest rates, 1988 to 1992...........	6.64	24.20	5.80	-3.80	2.50	-0.37
Period of falling interest rates since 1992	6.51	24.34	2.90	-5.60	0.12	-0.22
For comparison: yield on public bonds outstanding						
Start-1985 to end-1989......	6.96					
Start-1990 to August 1996	7.77					
Period of falling interest rates, 1985 to 1988...........	7.37	24.91	3.10	-3.90	0.20	-0.27
Period of rising interest rates, 1988 to 1992...........	5.15	13.59	2.70	-2.40	0.23	-0.20
Period of falling interest rates since 1992	9.82	24.35	5.30	-2.80	0.33	-0.20

* Volatility calculated as annualised standard deviation of relative daily changes of interest rates and yields within a month.

tended to diminish (Chart 7[13]). The very small fluctuations at the beginning of the nineties are due to the fact that at the time the day-to-day money rate was running close to the lombard rate, and that the possibility of fluctuations – at least upward fluctuations – was therefore technically very limited; since the autumn of 1992, by contrast, the day-to-day money rate has been moving around the middle of the

[13] The time series for the day-to-day money rate has been adjusted at this point for frictional fluctuations on the last trading day of the month. The last day of the compliance period is often characterised by imponderables. As a rule, the Bundesbank takes no action; rate fluctuations on the last day of the month are not assigned any function by market participants.

interest rate corridor. Moreover, historical volatilities (measured in terms of the annualised standard deviation of the relative change) show that, since the end of the eighties, the average fluctuation has been independent of the interest rate trend. In periods of rising day-to-day money rates, it is no different from that in periods of falling interest rates (Table 3).

An optimum volatility in the day-to-day money market is not theoretically quantifiable. On the one hand, the day-to-day money rate should be allowed to "breathe" in order to be able to indicate correctly the supply and demand conditions in the market for central bank balances (for that reason the interest rate corridor should not be set too narrowly); on the other, functionless and erratic fluctuations in the rate, which may trigger undesirable expectations in the market and provoke intervention by the central bank merely for the sake of taking action should be avoided. Hence, the Bundesbank is not endeavouring to prevent volatility completely. Accordingly, its intervention frequency in the money market is not guided by what is technically possible, but is limited to the measure that is necessary in monetary policy terms. This means that volatility in the day-to-day money market should be manageable to the extent that the Bundesbank is in a position at any time to make an interest rate policy change of direction, or to make the desired interest rate trend in the money market recognisable without newly approving the interest rate corridor or announcing a modified fixed-rate tender rate in advance.

In addition, the Bundesbank can gauge its liquidity provision in such a way that the actual course of compliance with the reserve requirements deviates from the uniform monthly pattern aimed at by the banks. The movement of the day-to-day money rate initiated by such a front-loaded or back-loaded central bank money provision or compliance with the reserve requirements is reflected in a corresponding change in the banks' bidding behaviour if the variable-rate tender is used. Over the short term, the Bundesbank may in the process become somewhat dependent on the credit institutions. Especially if interest rate expectations are very homogeneous, the banks' demand curve may be very flat, with the result that the Bundesbank is hardly able to influence the variable-rate tender rate on the day of the auction by means of its operating parameter, i.e. by varying the volume. However, in this case it may set the amount of the purchase in such a way that in the following week the supply and demand conditions in the money market largely force the banks to bid in the manner desired. The Bundesbank uses this procedure of comparatively unobtrusive interest rate management fairly frequently, and thus endows the resetting of the interest rate corridor, which normally follows, with something of a confirmatory character. Even so, it has to be said that even a traditional change in key interest rates prepared in this way may trigger market price reactions.[14]

Recourse to the liquidity channel can, however, only be successful if, firstly, the Bundesbank foresees market-determined liquidity shocks with sufficient reliability and, secondly, the banks' behaviour is not determined by pronounced expectations of interest rate changes. In the latter case, as also in periods of enhanced instability of the financial markets, the Bundesbank therefore opts for the fixed-rate tender to give the market guidance. Interest rate expectations may soon push the variable-rate tender rate against the limits of the interest rate corridor – regardless of the banks' current provision with liquidity by the Bundesbank. In periods of rising interest rates, the repurchase rate soon moves close to the lombard rate and the Bundesbank risks falling into the lombard trap; i.e. in expectation of continuously rising interest rates, the credit institutions make heavy use of the lombard window so as to comply with their reserve requirements in advance. The lombard rate assumes the function of the operational key interest rate, and the repo instrument becomes ineffective. If, in periods of falling interest rates, the repo rate approaches the discount rate, the discount trap opens up. The banks reduce their borrowing at the discount window because they no longer wish to borrow for three months at current terms. The liquidity needs to be met through open market operations can no longer be forecast with sufficient accuracy, and sharp fluctuations in the day-to-day money rate can hardly be prevented. Exceptional reactions on account of expectations of changing interest rates cannot be ruled out completely in the case of fixed-rate tenders either. At the end of January 1994, for example, the banks no longer generated any demand for the liquidity they actually needed ("bidder

14 See Hardy (1996).

strike") since they felt that the fixed-rate tender rate set by the Bundesbank was too high, and speculated on a later provision of funds at a lower price.

Despite these qualifications, money market management through securities repurchase transactions has proven its worth. Although repurchase transactions are no substitute for day-to-day money, the repurchase rate has assumed the interest rate leadership in the day-to-day money market. This applies both on average over a fairly long period and in a very short-term day-to-day perspective. Market rates respond direct to the announcement of a changed repo rate. In the case of fixed-rate tenders announced in advance, the market responds already in advance of the actual tender date; on the allotment day itself the additional information consists only in the volume allotted. In the case of variable-rate tenders, by contrast, the market response becomes apparent directly on or around the allotment date. Even when the frequency of intervention was low, major fluctuations in the day-to-day money rate could be prevented thanks to the cushioning function of the minimum reserves. The Bundesbank has become much more flexible in its interest rate policy. Where repurchase rates are concerned, variations can be confined to small steps, and major errors can be avoided when decisions must be taken in uncertain circumstances. As a rule, the Bundesbank therefore "feels its way" towards the desired interest rate conditions in the money market in small steps, by trial and error. Short-term open market policy measures often play a leading role in the process. Subsequent changes in the traditional key interest rates – the discount and lombard rates – therefore often have only a confirmatory character. This applies both to periods in which the Bundesbank wishes to pursue a more rigorous policy in the money market and to periods in which the Bundesbank is exploring the domestic and external scope for monetary relaxation.

3.2 Influence on short and longer-term market interest rates

The Bundesbank has the option of selectively pursuing a term structure policy in the money market, i.e. of implementing its ideas on the future trend in money market rates in the market, by varying the maturities of its repo transactions. Because of the risks involved and because there was no necessity, it has taken advantage of this operational option only to a limited degree (see Chart 6). The combination of two fixed-rate tenders with differing maturities, i.e. the variant of a term structure policy in the strict sense, was abandoned by the Bundesbank as early as 1986. It requires the central bank to have precise ideas about the desired movement of money market rates, in conformity with the monetary target, over a fairly long period, and to be able consistently to coordinate two operational target variables. It is, moreover, not necessarily desirable to narrow one's own interest rate policy leeway by indicating specific longer-term interest rate targets. Since 1986 the Bundesbank has therefore offered its longer-term repos exclusively in the form of variable-rate tenders. But even if two variable-rate tenders are combined, elements of the central banks' interest rate leadership (in the longer-term money market) are retained to the extent that the fixing of the allotment rate may still be interpreted as an interest rate policy decision. In the past three years the Bundesbank has entirely dispensed with the combination of tenders with different maturities. Its longer-term interest rate policy intentions can just as well be signalled by varying its interest rate corridor; moreover, tender combinations are not necessary in order to steady interest rate movements in the money markets – as will be shown below.

It is clear that very short-term market interest rates follow official Bundesbank interest rates[15] (Chart 8), but it should be mentioned here that the comparatively steady management of the day-to-day money rate alone is accompanied, by international standards, by a likewise fairly small volatility of short-term money market rates (Charts 7-9). In addition, it transpires that historical volatility in the money market – for example, that of the interest rate for three-month funds – has tended to decline, if anything, since the end of the eighties (Table 3).[16] Moreover, since the beginning

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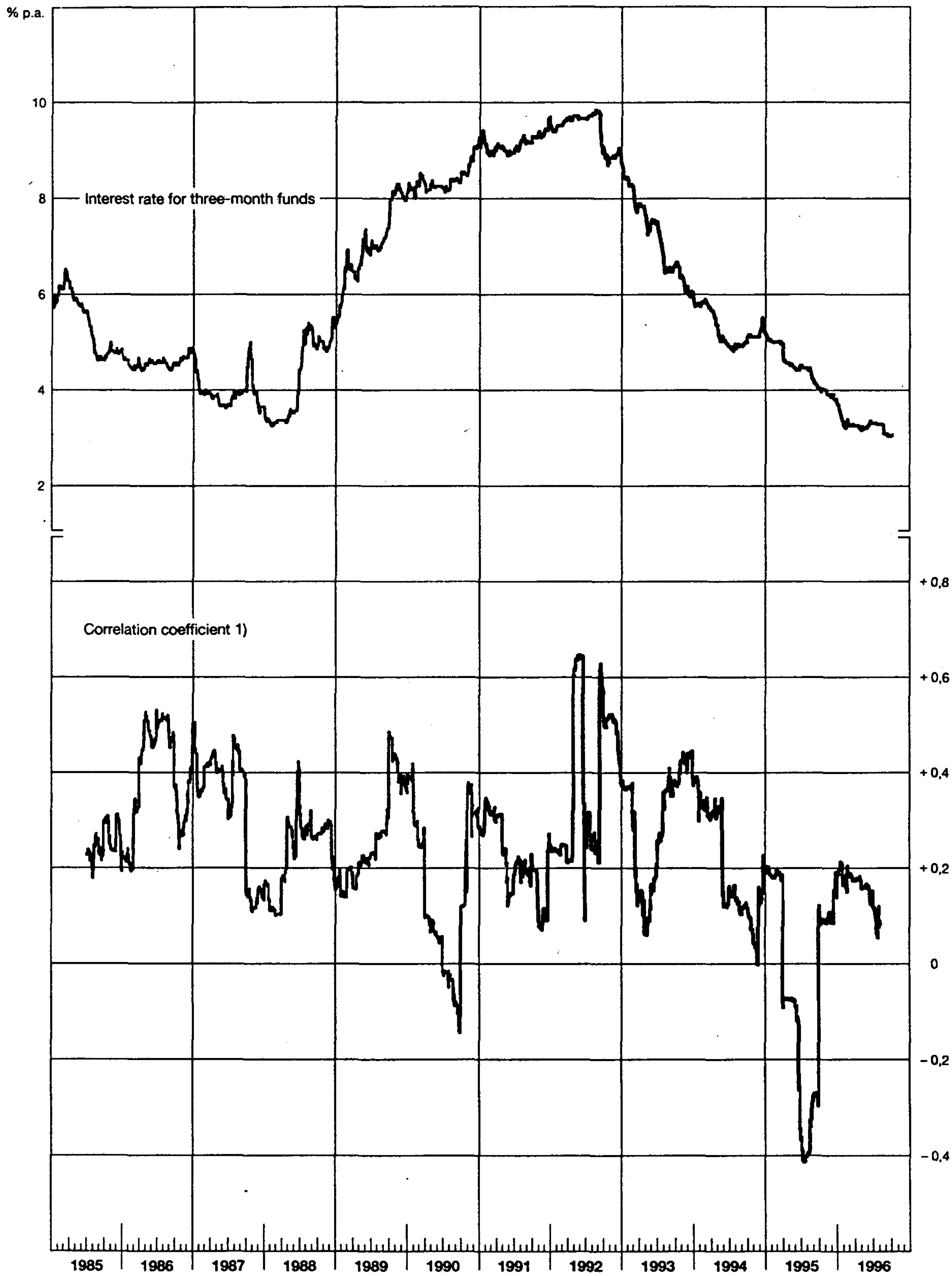
[15] For a detailed description of this, see Deutsche Bundesbank (1996b).

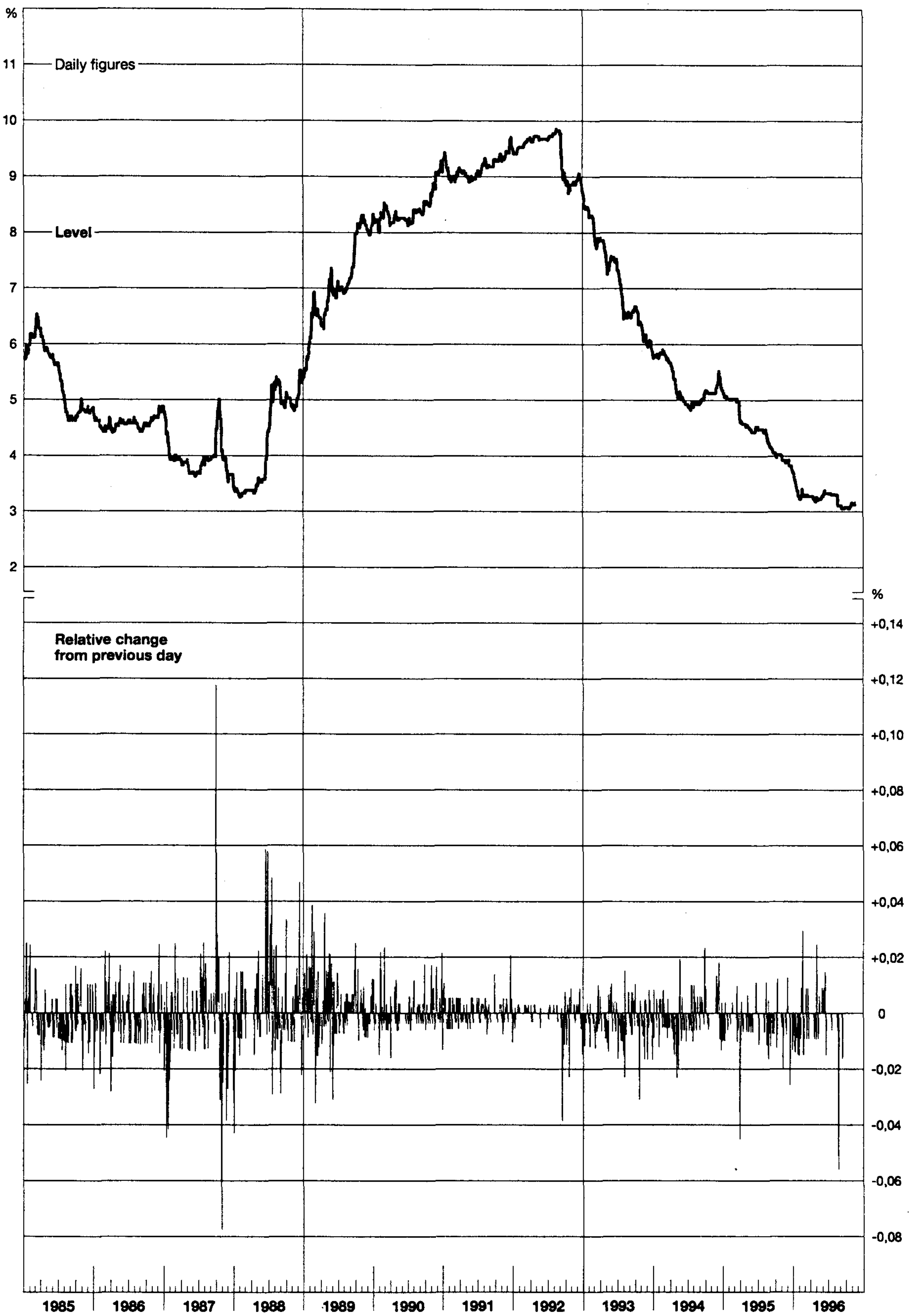
[16] For the trend in volatilities in the German financial markets since 1980, see also Deutsche Bundesbank (1996a).

Chart 8
Moving correlation of the percentage change in the day-to-day money and three-month funds rate
Daily figures



1) Moving correlation of 180 days.

Chart 9
Three-month funds rate
Level and relative change from previous day



of the nineties it has hardly been possible to distinguish between periods of lesser and greater price variability in this market segment. In the period of rising interest rates at the beginning of this decade, such variability was hardly different from that in the subsequent period of falling interest rates. Major swings occur at best in extreme situations, such as the EMS crisis in 1992, and in the environment of international speculation on falling interest rates, such as in the spring of 1995 (Chart 10). This suggests that the Bundesbank has succeeded in setting the monetary underlying conditions – at least over the shorter term – in a sufficiently transparent and credible way, and thus in stabilising the expectations of financial market players about future monetary policy. The movements of bank interest rates in shorter-term deposit and lending business with non-bank customers were correspondingly steady. The fiercer competition in the banks' liability-side business is likely to have contributed to the fact that nowadays the money market conditions set by the Bundesbank tend to affect short-term deposit rates more than they used to. In the case of short-term lending rates, by contrast, the impact may have slackened somewhat. This probably owes something to the fact that the direct link of lending rates to the discount rate is much less significant than previously. Furthermore, the signal effect of repo rate changes is smaller than that of discount rate changes.

The influence which the Bundesbank's monetary policy can exert on longer-term DM interest rates via the control of domestic money market rates is limited; *a priori* not even the sign of the link is always clear. Observable long-term nominal interest rates are determined by three components: the real interest rate, the risk premium and inflation expectations. There are doubts about the extent to which monetary policy can influence the real interest rate at all. Leadership in the capital market that dominates the real interest rate therefore cannot and is not to be achieved by means of the monetary policy instruments. The Bundesbank confines itself to keeping the inflation component low by pursuing a convincing anti-inflation policy and to announcing its intentions reliably and in conformity with its targets in order to minimise the risk premium.

Price movements in the financial markets are increasingly being determined by changes in expectations which reflect either longer-term growth and inflation prospects or only very short-term market forecasts. The growing presence in the German financial markets of internationally operating investors who, moreover, often pursue more short-term strategies has the result that price changes occurring abroad increasingly affect the domestic markets. This is clearly reflected in the growing transfer of short-term price movements from the US to the German bond market. In addition, taken by themselves, new trading techniques and the extension and refinement of trading in derivatives have helped to accelerate the pace of response to changes in expectations and their impact. In the upshot, the potential volatility of the DM capital market is likely to have increased, as is also the danger of exaggerated price movements which may distort relative price patterns.[17]

The Bundesbank must be anxious to prevent excessive volatility in the capital market (and in other financial markets). Although the Bundesbank's policy is not guided primarily by the price indicators of the longer-term financial markets, their high volatility may impair the stability of the monetary policy transmission process, which is required for a monetary targeting strategy. It would certainly be of no avail to seek to counter price fluctuations selectively by deploying monetary policy instruments; for one thing, the unambiguous identification of undesirable price movements is hardly possible; for another, monetary policy should not run the risk of becoming the cause of financial market unrest itself. Instead, the Bundesbank is endeavouring, as a precautionary measure, to limit financial market volatility which is strongly marked by expectations by keeping expectation uncertainties low. The low volatility discernible in the DM money markets should spread to the downstream markets. In point of fact, a national comparison shows a positive correlation between the volatility of both maturity categories.[18] (This perception is not an unambiguous statement on the causality, however; a transfer of uncertain expectations in the capital market to the money market is likewise feasible.) In Germany the link between volatility in the money market and volatility in the

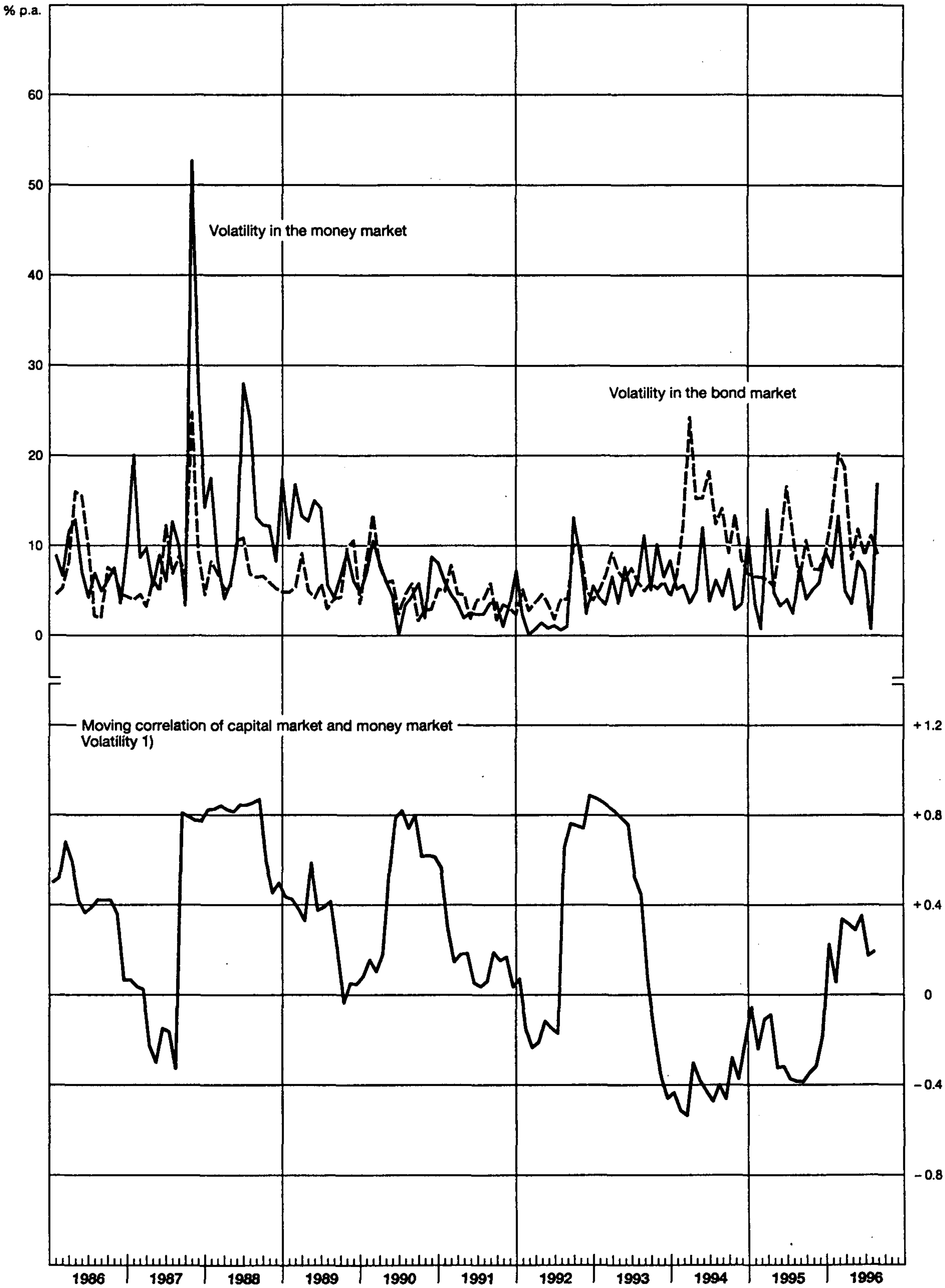
[17] See Domanski and Neuhaus (1996).

[18] See Borio and McCauley (1996).

Chart 10

Volatility in the money market and in the bond market*

Monthly figures



* Volatility calculated as the annualised standard deviation of the relative daily yield and interest rate changes within a month.-
1 Moving correlation of 12 months.

bond market is small (Chart 10). This warrants the conclusion that the sharp fluctuations in volatility in the bond market (spring 1994 and 1996) were scarcely provoked by the Bundesbank's policy, but were rooted primarily in the international environment.

Experience for Germany shows that the containment of uncertain expectations can be achieved by maintaining stable underlying conditions, to which monetary policy can make a major contribution by pursuing a transparent and credible strategy. In addition, the Bundesbank has attempted, particularly in the last few years, to stabilise market expectations by pursuing a "steady-as-she-goes" monetary policy, and to counter volatility in the financial markets. For that purpose it stuck to the fixed-rate tender at unchanged interest rates for long periods and, moreover, announced the terms in advance. In such periods a changeover to variable-rate tenders might easily have given rise to misunderstandings about the stance of interest rate policy. On the one hand, the Bundesbank has no full control over the allotment rate in this case. On the other, the markets often assign even to fairly small deviations from the previous tender rate, which are irrelevant in monetary policy terms, an importance which is not appropriate to the situation. To this extent, the expectations that the Bundesbank would be able to act more unobtrusively by means of securities repurchase transactions have only partly come true.

4. Information provided and used by the Bundesbank

The responsiveness of the financial markets to expectations, i.e. their sensitivity to new information, has in general increased noticeably. In order to guide market expectations, the Bundesbank cannot rely solely on the deployment of its "substantive" monetary policy instruments; an effective information policy is likewise required. The Bank's statements and measures influence the expectations of market participants and thus the impact of its monetary policy. On the other hand, the Bundesbank requires a very broad range of information, *inter alia* on market expectations, which is used not only to monitor the effects – as described in the preceding section – but is also useful ahead of monetary policy action. Basically, this means that, on the one hand, the Bundesbank gives guidance to the financial markets and, on the other, it uses their movements as an information input. The success of its policy depends crucially on the extent to which agreement is reached, or disagreements become known, between the central bank and the market regarding the assessment of overall market conditions; in the event of disagreements and ignorance, misinterpretations of monetary policy measures are easily possible.

The Bundesbank is pursuing an intensive information policy. In its regular publications and in frequent public statements it analyses current monetary policy conditions from its point of view and, against this background and with its potential-oriented monetary targeting strategy as a guideline, it elucidates the deployment of its instruments in detail. There should therefore be no misunderstandings about the basic philosophy of German monetary policy – its mandate, its strategy and its orientation. The Bundesbank's medium-term inflation assumption and its intermediate target are well known. Deviations from the monetary target must be justified. Accountability and transparency are therefore undoubtedly important factors of the Bundesbank's policy.

Transparency and accountability should not result in day-to-day monetary policy becoming completely calculable, however. The Bundesbank is therefore endeavouring to take due account of possible market reactions to its activities without becoming a slave to market views or individual indicators. For example, it recently supplemented its information input by adding expectation indicators deriving from financial market prices, i.e. the prices of derivatives and particularly of options. These are indicators both of the future level of interest rates/prices and of their spread. The latter, in particular (ascertained in the form of implicit volatilities), is gaining increasing importance as a measure of uncertain expectations. However, it can be used only with qualifications as a forecast value of future volatilities. It often correctly indicates the sign of the change in volatility, but rarely predicts the actual size of the change. In the context of its monetary policy strategy, the

Bundesbank assigns to expectation indicators only the significance of additional information and monitoring variables, but does not give them an autonomous function as monetary policy benchmark or operational variables. For monetary policy, this poses the risk of being towed along by expectations and becoming susceptible to speculative movements. Finally, this approach could be interpreted as a change in the monetary policy regime, and alter the process of forming expectations and the behaviour of the market; this would destabilise the underlying monetary relationships and possibly necessitate a departure from the medium-term orientation of monetary policy.

The Bundesbank's information policy is in line with this. For example, no minutes or votes of the meetings of the Central Bank Council are published. This would adversely affect the free exchange of opinions within the Central Bank Council. Nor are there any longer-term directives on the management of the money market in Germany, such as those in the United States. Furthermore, the Bundesbank exercises restraint with respect to forward-looking statements. For instance, it does not publish any forecasts which it makes by means of its econometric model or partial econometric conditional equations, e.g. for monetary growth. It refrains from publishing forward-looking money market and liquidity analyses, and confines the announcement of its regular open market operations to the type of tender (in the case of fixed-rate tenders, also the repo rate) and the maturity, while the planned amount to be purchased is not published. The announcement is made either on the day of the auction or in advance after Central Bank Council meetings. The restrictive provision of forecasts protects monetary policy from tying its own future actions to statements made under conditions of uncertainty. The Bundesbank thus creates room for manoeuvre which enables it flexibly to shape the operational implementation of its monetary targeting policy in a volatile environment.

It is not automatic responses which are required here, but a careful assessment of all relevant facts. This includes decisions which come as a surprise to the markets. An ancillary condition is, however, that the stability of the financial markets should not be jeopardised. Price adjustments and market fluctuations should not occur in a shock-like manner. A balance must be found in order to maintain the leading role of monetary policy and to do what is necessary in monetary policy terms, while preventing major market disturbances.

Conclusions

The deployment of the Bundesbank's policy instruments has changed since the beginning of the eighties. Central bank balances are provided not so much in the context of bilateral refinancing operations with individual banks as through securities repurchase transactions. The minimum reserves are not so much an instrument to manage bank liquidity as a cushion in the money market. This means that the Bundesbank has become much more flexible in its money market policy. On the other hand, money market policy continues to be marked by a low intervention frequency. Nevertheless, developments in the money market are relatively steady. Although repos are no substitute for day-to-day money, the repo rate has assumed a leading function in the day-to-day money market. Interest rate changes in the money market work through to shorter-term bank interest rates relatively rapidly. However, the scope for exerting an influence in the capital market has decreased owing to its growing responsiveness to expectations and its increasing short-termism. These factors argue in favour of a credible and transparent monetary policy strategy which gives guidance to the markets. In addition, the Bundesbank has attempted to counter the volatility of the financial markets by a "steady-as-she-goes" monetary policy. For this purpose it has repeatedly stuck to fixed-rate tenders at unchanged interest rates for a long time. Over and above this, the Bundesbank is pursuing an intensive information policy in order to document the appropriateness of monetary policy and to stabilise the financial markets. The transparency and accountability of monetary policy cannot lead, however, to day-to-day monetary policy operations becoming completely calculable. They would then be altogether in the wake of the markets. Here a balance must be found which leaves monetary policy its leading role, but avoids major market disturbances.

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Recent changes in Austrian monetary policy instruments and procedures

Michael Pfeiffer and Margarethe Quehenberger[1]

1. Basic goals of Austrian monetary policy

The basic long-term goal of monetary policy as laid down in the National Bank Act and pursued by the Oesterreichische Nationalbank (OeNB) is price stability. With a view to achieving this primary goal, the OeNB uses the exchange rate as an intermediate target and tries to keep the Austrian schilling stable against the currencies of the stable-currency countries, in particular, against the Deutsche mark. With this strategy the OeNB fulfils the requirements of the National Bank Act, ensuring *"... that the value of the Austrian currency is maintained with regard both to its domestic purchasing power and to its relationship with stable foreign currencies"* (Article 2, paragraph 3). Since 1995 Austria has been a member of the European Exchange Rate Mechanism (ERM), which, however, left the basic strategy of Austrian monetary policy unchanged.

The essential qualitative elements which have evolved from the economic policy environment since the 1970s are the import of price stability (exchange-rate-price spiral as a virtuous circle) and, later on, the stabilisation of expectations with regard to both the intermediate and the final target. Credibility in the context of a fixed exchange rate regime requires interest rate policy to be subordinated to the exchange rate objective. This implies an endogenously determined money supply. The alternatives available to the central bank consist of influencing the structure of money supply, i.e. the domestic and foreign source components.

Since domestic and foreign financial assets are not perfectly substitutable, the Austrian yield curves are not identical with the German ones. However, as the credibility of Austria's exchange rate policy increased, the originally positive interest differential to the anchor currency area narrowed, not only at the short end (where the overnight rates repeatedly even fell below the German ones), but also at the long end of the interest curve. The (current) options for a – moderately – autonomous interest rate policy are the result of comparatively favourable fundamentals and of the high degree of monetary policy credibility.

As far as practical implementation is concerned, the daily determination of exchange rates – the so-called exchange rate fixing – forms an integral part of this policy and is performed autonomously by the OeNB.

The operational target of the OeNB is to minimise fluctuations of short-term money market rates. This task is greatly facilitated by the imposition of minimum reserve requirements imposed on the banking sector.

The changes in the types of accommodation of the demand for central bank money and of the OeNB's options of fine-tuning the money market have to be seen in the broader context of the liberalisation of financial markets and the resulting call for greater flexibility. Therefore, in line with other industrial countries and given harmonisation efforts due to the envisaged operational framework of the European System of Central Banks (ESCB), the OeNB has adapted its operational framework. The predominance of standing facilities has been ended and open market operations have gained crucial importance.

This paper provides a short summary of the development of the operational system of monetary policy in Austria. First, the traditional instruments and the prevailing money market conditions are described. It is shown why this system has been successful and why, nevertheless, there

[1] The authors would like to thank Mr. Andreas Nader for providing the statistical material.

were reasons for reform. Second, the new measures taken and their rationale are presented as well as the main features of the current system. Finally, a few remarks on the potential need for further harmonisation measures are added since Austria wants to participate in Stage III of Monetary Union from the very beginning.

2. The old framework of the refinancing system

2.1 Standing facilities

Central bank money was predominantly provided to the Austrian banking sector by means of "standing facilities" (demand-oriented facilities at the initiative of the commercial banks). About 60 banks had a permanent refinancing volume (refinancing ceiling) at their disposal. Although there was no formal link, there was a loose connection between the total refinancing limit and the amount of central bank money necessary for the banks to fulfil their minimum reserve requirements. Within this framework, there existed basically three refinancing possibilities:

- Rediscount of bills of exchange;
- Securities repurchase deals;
- Lombard loans.

2.1.1 Rediscount of bills of exchange

The discount facility was restricted to providing a 40% maximum of the total refinancing ceiling. This restriction was necessary because the discount was offered at an interest rate below market. If banks had expected interest rates to increase, they could have used this facility too extensively and thus would have undermined the effectiveness of increases of the GOMEX rate.

The importance of the discount of trade bills decreased in the last few years, especially at times when the interest rate differential between the GOMEX and the discount rate narrowed (the discount facility involves rather high handling fees). Other reasons were expectations of falling interest rates, which, at times, made the discount less attractive due to the maximum maturity of 3 months (which meant that banks' positions would be locked in for a rather long period of time).

However the discount rate continued to play an important role in signalling the broad monetary policy stance of the OeNB.

2.1.2 Securities repurchase deals

The largest part of refinancing was effected by means of securities repurchase deals or so-called GOMEX transactions between the central bank and commercial banks pursuant to Article 54 National Bank Act, which regulates open market operations.[2] These transactions were carried out at a due-at-call basis. The majority of large banks used them as a de-facto overnight facility. The GOMEX rate was one of the interest rates of the OeNB that conveyed the monetary policy stance to the money market and functioned as an effective peg for overnight rates.

Moreover, there was a so-called special open market facility with a limit on the amount of repos (and/or FX swaps) within which the OeNB could offer additional funds to cover temporary liquidity shortages in the money market. In a few specific situations the OeNB offered one-week repos (with the opportunity of prolongation if necessary). This facility was the first to be offered in the form of tenders.

2 The international definition of open market operations rather refers to transactions conducted at a central bank's discretion; the GOMEX is therefore to be subsumed under standing facilities.

Besides, a rather limited – in terms of disposable volume – restrictive facility called REGOM was available which was based on the issue of central bank certificates.

2.1.3 Lombard loans

A lombard loan under the old system denoted the possibility of granting a short-term loan (maximum: 3 months) against securities as collateral, as laid down in Article 51 National Bank Act. Until the adaptation of refinancing facilities of the OeNB in October 1995, the lombard was included in the refinancing ceiling. Since the lombard rate, which is also set by the Bank's Generalrat, was fixed above market rates, this facility was hardly used in the past.

2.2 Minimum reserves

Minimum reserve requirements have been an important instrument to stabilise money market rate fluctuations in Austria and to create or enlarge a money market liquidity shortage; i. e. a stable demand for central bank money. This is predominantly important for countries that face a structural liquidity surplus. Reserve ratios have been chosen to be sufficiently high to guarantee reserve requirements that are clearly higher than the working balances of banks.

In spite of the fact that the OeNB adapted its reserve requirement system, several key elements have remained unchanged. The averaging provision with a maintenance period of one month helps to buffer a good deal of liquidity fluctuations and therefore acts as a stabiliser for short-term money market rates. In addition, there are no limits on deviations of daily reserve holdings from the required average (however, there is no overdraft facility). These features contribute to an increase in the interest elasticity of the demand for liquidity and consequently help to reduce volatility in money market rates – the only exception being the end of the maintenance period when volatility in the overnight rate tends to increase ("ultimo" effect).

As regards the fulfilment of reserve requirements, there existed some specific features that have been abolished in the course of the implementation of EU legislation. Certain banks were allowed to use Treasury certificates as a fixed part of their required holdings, which implied a low-level interest rate for this part of their reserve requirements. Moreover, up to 25% of the individual requirements could be fulfilled through vault cash.

2.3 The Austrian money market

Generally speaking, the major features of the money market in the old system are still valid. Potential future changes due to the adjustment of monetary policy instruments and procedures are briefly discussed in Section 5.

The Austrian money market has been characterised by an oligopolistic structure with relatively low market depth and a lack of classic money market papers like commercial paper or certificates of deposit. Of course, all kinds of derivative instruments are used by Austria's large banks, although the market is still somewhat under-developed. A few large commercial banks, the central institutions of sectoral banks and especially the Postal Savings Bank (the fiscal agent of the Treasury) are the key market players.

In the Austrian money market, the call money rate predominates. Given the minimum reserve maintenance period of one month, there is some liquidity in the segment including maturities up to one month, but there are rather modest activities in the longer money market maturities, i.e. up to one year.

The lack of money market papers was partly traceable to the stock exchange turnover tax, which was abolished in 1994. As a kind of substitute, a special type of short-term credit (especially vis-à-vis industrial enterprises), "Barvorlagen", was developed. These short-term credits with maturities of up to 6 months were frequently used and had near money-market qualities.

In 1995 the Austrian government – in coordination with the OeNB – started issuing short-term papers known as "Geldmarkt-Bundesschatzscheine" on a regular basis (current volume: Sch 100 billion) in order to increase money market liquidity.

Another specific feature of the Austrian money market results from the multi-tier banking system, where the sectoral banks have access to the refinancing facilities via their central institutions. Liquidity management within the sector often causes the central institutions to use the money market primarily for balancing their peaks.

2.3.1 Volatility in the money market

The OeNB has been very successful in minimising fluctuations of the overnight rate. This has increased money market efficiency and retained the central bank's signalling capacity. Any fluctuations occur towards the end of the minimum reserve period.

2.4 Summary of features of the old refinancing system

The old refinancing system provided an efficient liquidity framework:

- It ensured a high degree of stability, which means the system was very efficient in minimising fluctuations in the money market (only exception: the aforementioned "ultimo" effect).
- It provided a flexible solution for the commercial banks (they were in a position to manage their liquidity position on a daily basis according to their individual needs) as well as for the OeNB, which did not face the necessity of intervening regularly or very often.
- To a great extent, the banks themselves had to assume responsibility for their own liquidity management. This favoured a cautious demand-oriented use of central bank facilities.

More generally, the minimum reserve system along with standing facilities that could be used by banks in a highly flexible way provided an efficient framework for decades, enabling the Oesterreichische Nationalbank to reach its intermediate and final goal (exchange rate stability and price stability) as well as its operational goal (minimising the volatility of the overnight rate).

2.5 Reasons for reform

- There was clearly a need for harmonisation with international requirements.[3] As the tender was to be the predominant liquidity-providing instrument of the ESCB, any country that envisaged participating in Stage III from the very beginning had to adapt its monetary policy instruments. This entails the preparation of the necessary

[3] Refinancing conditions in Austria can potentially also be influenced during the fixing. Under normal circumstances, a policy of the "smallest net position" is pursued. This means that efforts are focused on keeping the repercussions of foreign currency flows to a minimum. On the other hand, occasional deviations from this policy are taken into account to engineer changes in the domestic liquidity situation and to help stabilize confidence in the DM/Sch parity. Moreover, the OeNB has always aimed at keeping the DM/Sch fluctuations at a low level in order to pave the way for more or less risk-free DM/Sch interest rate arbitrage in the call money segment. This implies that banks can make use of the German money market to fine tune their liquidity position. Moreover, it explains why the OeNB has rarely intervened in the money market in the past.

instruments in time to give the banks – and the central bank itself – some leeway to gain experience before entering into Monetary Union.

- The quota system might have distorting effects on the money market, since the calculation and adjustment of refinancing ceilings for individual banks may not always fully reflect their dynamic development. During the previous decades, the calculation base of the individual refinancing ceilings was changed several times. Until the beginning of the 1970s, only equity capital was used as a basis. Later primary deposits were also taken into account. In the mid-80s, growth of the consolidated liable capital served as the base. At the beginning of this decade, the respective share of domestic business (balance sheet total minus interbank and foreign transactions) was used to calculate refinancing ceilings. This development might explain why some distortions regarding individual refinancing ceilings of banks may have been hard to prevent.
- In a system that is based exclusively on standing facilities, exceptional circumstances may restrict the central bank's room for manoeuvre (with standing facilities not fully used; e. g., the restrictive measures of the central bank may have a relatively weak impact in its effort to combat currency speculations).
- There was some need to bring reserve requirement ratios more in line with those of other European countries to improve the competitive position of Austrian intermediation.

3 The current refinancing framework

As has been pointed out, one of the main driving forces for restructuring the Austrian refinancing system was certainly the need to harmonise Austria's monetary policy instruments and procedures with those of the key EU countries. The OeNB saw the need to give the Austrian banks and itself the opportunity to get used to techniques which had been used only occasionally in the past and which the OeNB clearly recognised will be the dominant ones in a new system of European central banks.

3.1 Tender facility

- A regular tender facility with a frequency and maturity of one week was introduced in 1996 (there will be a change to a maturity of two weeks in early 1997). Up to now it has been implemented as a fixed-rate tender, in order to establish a clear margin between the GOMEX and the tender rate and clearly signal to the market that the tender facility is thought to outbid the attractiveness of the GOMEX as a basic refinancing facility. The relatively short maturity chosen was due to the fact that neither the banks nor the OeNB had sufficient experience with regular tender operations and thus both sides would be able to correct imprecise liquidity estimates.

Clearly, a more active engineering of market conditions implies a higher degree of responsibility for the central bank to provide accurate liquidity forecasts within shorter periods. The counterparts of the OeNB as well as the central bank have to get used to the fact that the regular tender will be the main liquidity-providing facility.

- It was considered a reasonable "package" to reduce reserve ratios on the one hand and to lower the refinancing ceiling by more than the amount of central bank money set free through the reduction of the reserve ratios on the other hand.

With these measures, the OeNB could – theoretically – create an artificial demand for money sufficiently high to supply liquidity via the tender facility to be newly installed.

In practice, however, during the last few years, the OeNB has been repeatedly faced with the situation of a huge general liquidity surplus in the money market due to massive foreign exchange inflows, which substantially reduced the refinancing needs of the banks and led to a significant reduction in the average use of standing facilities.

Given that situation, a further incentive had to be created in order to win the banks over to use the new system.

- Thus, while the OeNB had to reduce central bank key rates in line with the requirements of its exchange rate target, the GOMEX was kept at an artificially high level, whereas the tender rate was reduced.

3.2 Remaining (modified) standing facilities

The measures described above have led to an almost unutilised GOMEX facility during the last months, so that the GOMEX as the basic refinancing instrument has de-facto been replaced by the regular tender facility, and the only standing facility which is still of some importance is the discount facility. In principle, the discount window and the GOMEX transactions are still covered in a reduced refinancing ceiling, although, as a result of the aforementioned practice, their importance has waned. Through this more active way of influencing liquidity in the money market, the fixing mechanism potentially lost importance in liquidity management.[4]

The reformed lombard facility serves as a kind of standing facility outside the refinancing ceiling (which means that access to this facility is only limited by the amount of the available collateral). It is designed to function as an emergency lending facility which should not be used for structural refinancing purposes. This implies that it is a very short-term facility, in fact an overnight facility for individual liquidity problems predominantly at the end of the day, and definitely not for liquidity shortages across the market. Therefore the rate provides a ceiling for the market rates. This facility has not yet been used by the banks as the money market is very liquid and there have been no unexpected liquidity management problems so far. This is bound to change next year when the RTGS, which is currently in preparation, starts operating. This system will provide intraday liquidity to participants on a collateralised basis. A provision like this implies that the central bank might face a potential spillover into overnight credits which have to be covered.[5] The overnight credits have to be provided at a rate sufficiently above market rates to, as much as possible, prevent participants from speculative abuse. Most of the EU central banks – as well as the OeNB – envisage to cover such overdrafts (as far as participants from the euro area are concerned) via the marginal lending (lombard–) facility.

3.3 Restrictive instruments

For the purpose of structural as well as fine-tuning liquidity-absorbing transactions, a long-term OeNB paper with a maturity of 10 years was issued already in 1994. This issue can be used

4 Refinancing conditions in Austria can potentially also be influenced during the fixing. Under normal circumstances, a policy of the "smallest net position" is pursued. This means that efforts are focused on keeping the repercussions of foreign currency flows to a minimum. On the other hand, occasional deviations from this policy are taken into account to engineer changes in the domestic liquidity situation and to help stabilize confidence in the DM/Sch parity. Moreover, the OeNB has always aimed at keeping the DM/Sch fluctuations at a low level in order to pave the way for more or less risk-free DM/Sch interest rate arbitrage in the call money segment. This implies that banks can make use of the German money market to fine tune their liquidity position. Moreover, it explains why the OeNB has rarely intervened in the money market in the past.

5 This refers to situations which trigger the use of an overnight emergency lending facility, such as the unforeseen default on an expected payment by a counterparty of a bank.

in a two-fold way. On the one hand, as a standing facility (practically the liquidity-absorbing counterpart of a GOMEX deal, but with own issues of the central bank) for fine-tuning transactions of the banks themselves; on the other hand as an open market facility for the central bank. This facility was used by the banks in the first half of this year and provided a floor to market rates. This "floor-function" is also supported by the fact that it might be more efficient for banks to deposit excess money at the OeNB rather than to risk an exchange rate loss (of course this is – due to the small band of the Sch/DM parity – only true for huge volumes) via the fixing.

In addition, many of the short-term credits ("Barvorlagen") described above are indexed to the VIBOR (Vienna Interbank Offered Rate). Therefore, it seems more favourable for banks if money market rates are kept a bit higher than necessary in terms of liquidity in order to avoid losses due to indexation.

4 Information policy and predictability of interest rates

As mentioned above, the OeNB considers the stabilisation of the overnight rate to be of utmost importance, not only for increasing money market efficiency by keeping refinancing costs stable and low, but also for retaining the central bank's capacity to signal its monetary policy stance and to convey information to or get information from the market.

- The OeNB, in general, tries to pursue a very transparent liquidity policy vis-à-vis the banks taking part in the refinancing process. In practical terms, this means that the OeNB publishes – on a daily basis – the current amount of reserves at the OeNB and the average counting towards minimum reserve fulfilment.
- Moreover, the use of the individual refinancing instruments is published. This enables banks to make a rather accurate estimate of the liquidity need in the market. They know the reserve requirements of the system of the previous month and they can make use of estimates of liquidity-influencing factors like historical patterns concerning the probable development of the banknote circulation.
- As the Postal Savings Bank (PSK) is a major player in the money market and acts as a fiscal agent for the Treasury, there is also satisfactory information about liquidity movements due to government payments and receipts (e.g. tax dates, social security payments, etc.). At times, this bank exercises central bank functions in distributing liquidity among other money market participants or dominating the pricing policy in the market.

  Because of the PSK's important role in the market, the OeNB closely watches rate movements at this bank (also in different maturities which give indications of interest rate expectations) and thoroughly analyses developments in order to find out if they reflect distribution in the market or signal a general shortage or surplus.
- In addition, there are regular (daily) telephone contacts with the most important players in the money market, where – if necessary – additional information, e.g. about government transactions that result in foreign exchange in- or outflows, can be spread.

Overall, this transparency favours a moderate volatility of money market rates, just as it did in the old system of predominant GOMEX transactions. In a more market-oriented world, it will also ensure the predictability of monetary policy transactions by market participants with an adequate degree of accuracy. The predictability of interest rate movements is facilitated by the Bank's strict commitment to the stability-oriented exchange rate target and by the consistency of policies and policy signals that could be observed generally in the past.

Transparency and a high degree of credibility resulting from an impressive track record of monetary policy and from solid fundamentals and political stability can provide some room for manoeuvre for independent interest rate policies which has been proved during and after the EMS crisis in 1992.

For more than 15 years, the OeNB has faced practically no speculative attacks against the Schilling (with one minor exception). On the contrary, it temporarily gave up the more or less fixed positive spread against the DM because of permanent currency inflows. At times, the OeNB had to apply interest rates involving a negative spread to contain inflows. Otherwise the Sch/DM exchange rate would have exceeded the informally fixed band, and the use of the standing facilities would have converged to zero.

5 Prospects

By making the above mentioned adaptations of the system of monetary policy instruments and procedures, the OeNB took the necessary measures in the face of the challenges of the European Monetary Union.

Further changes may arise, e.g., in the field of counterparts. The question of whether any eligible counterpart of the ESCB must have direct access to the ESCB refinancing facilities is still open. At any rate, the definitive solution might lead to an increase of counterparts for the OeNB.

Another issue with a potential impact for the future might be the specification of eligible collateral. The proposed distinction between Tier One and Tier Two instruments implies some room for manoeuvre for national central banks. This might lead to considerations whether, for example, the use of different kinds of money market paper (like CDs and CPs) should be promoted by making them eligible for certain types of central bank refinancing. Positive effects on the liquidity and depth of the money market could result in this case.

Chart 1
Reserves and spreads between overnight rates of Austria and Germany

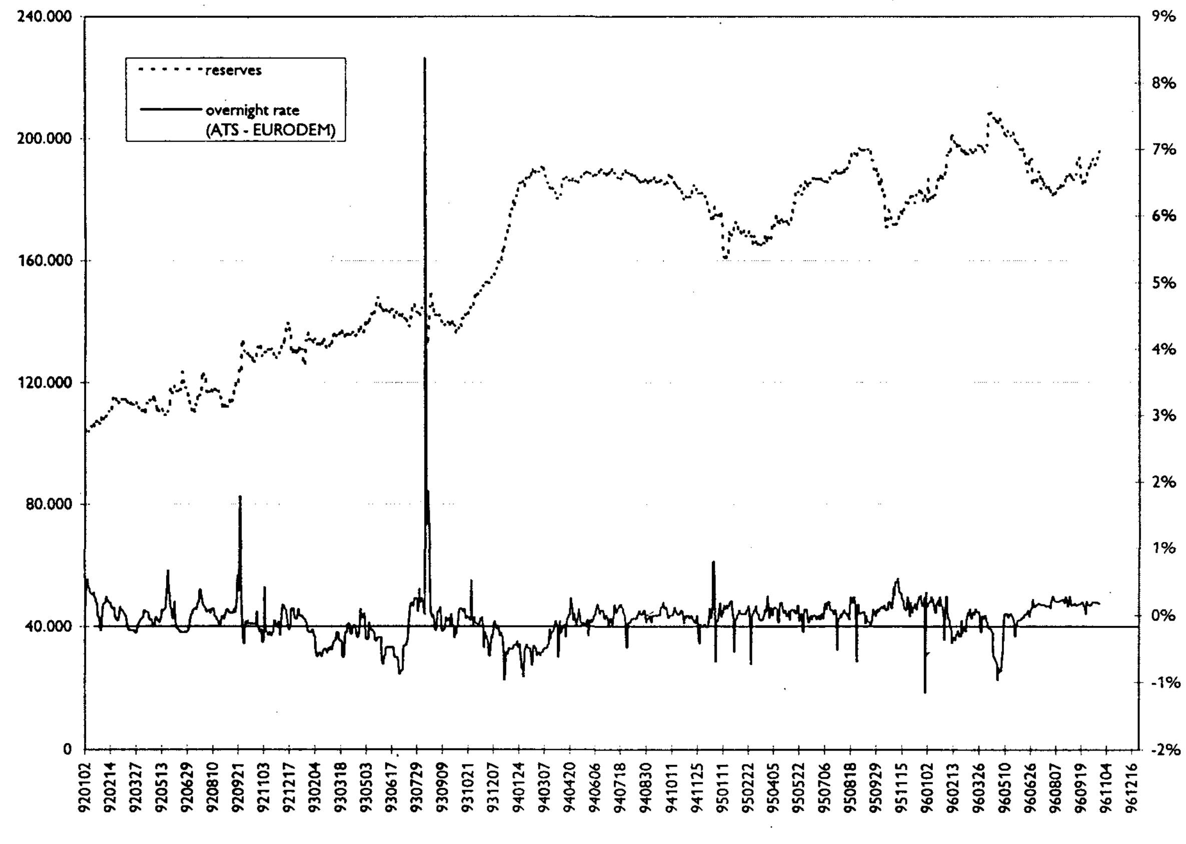


Chart 2
Spread between overnight rates of Austria and Germany

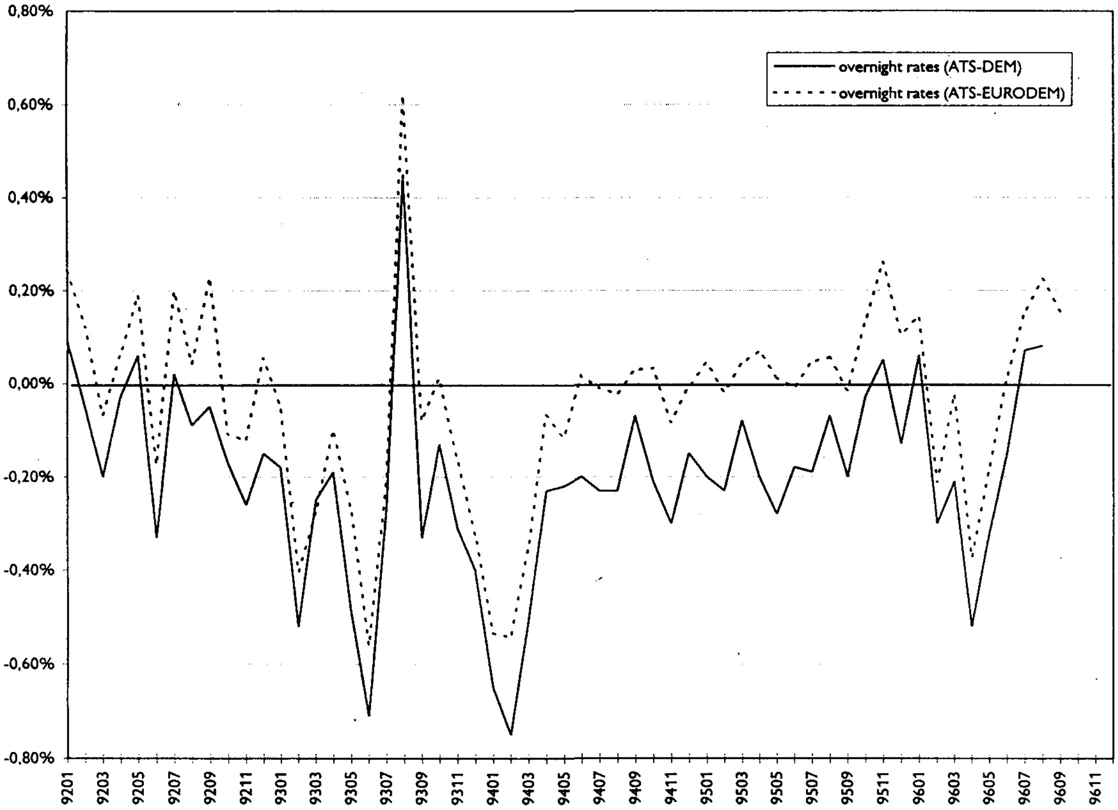


Chart 3
Austrian discount and overnight rates
1992 - October 1996

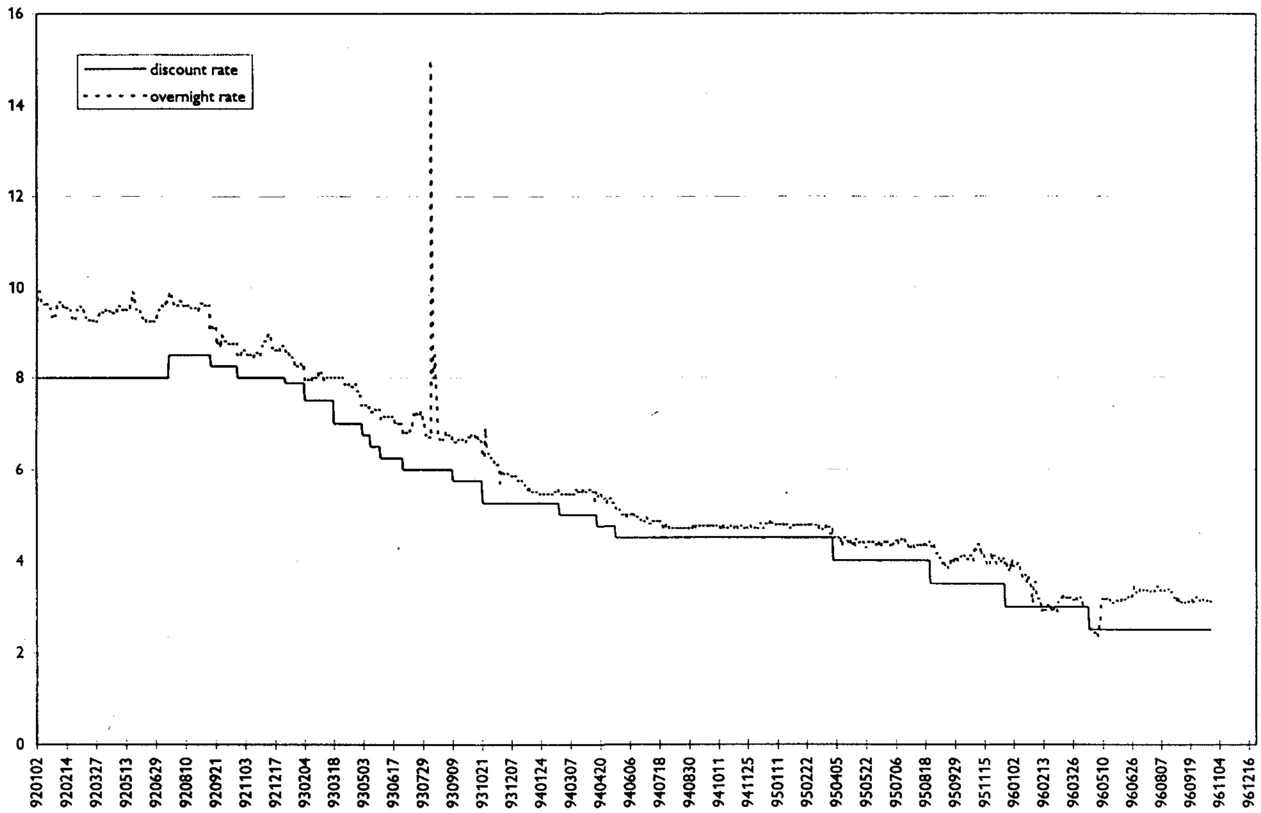


Chart 4
Volatility of the Austrian overnight rate
30-day average

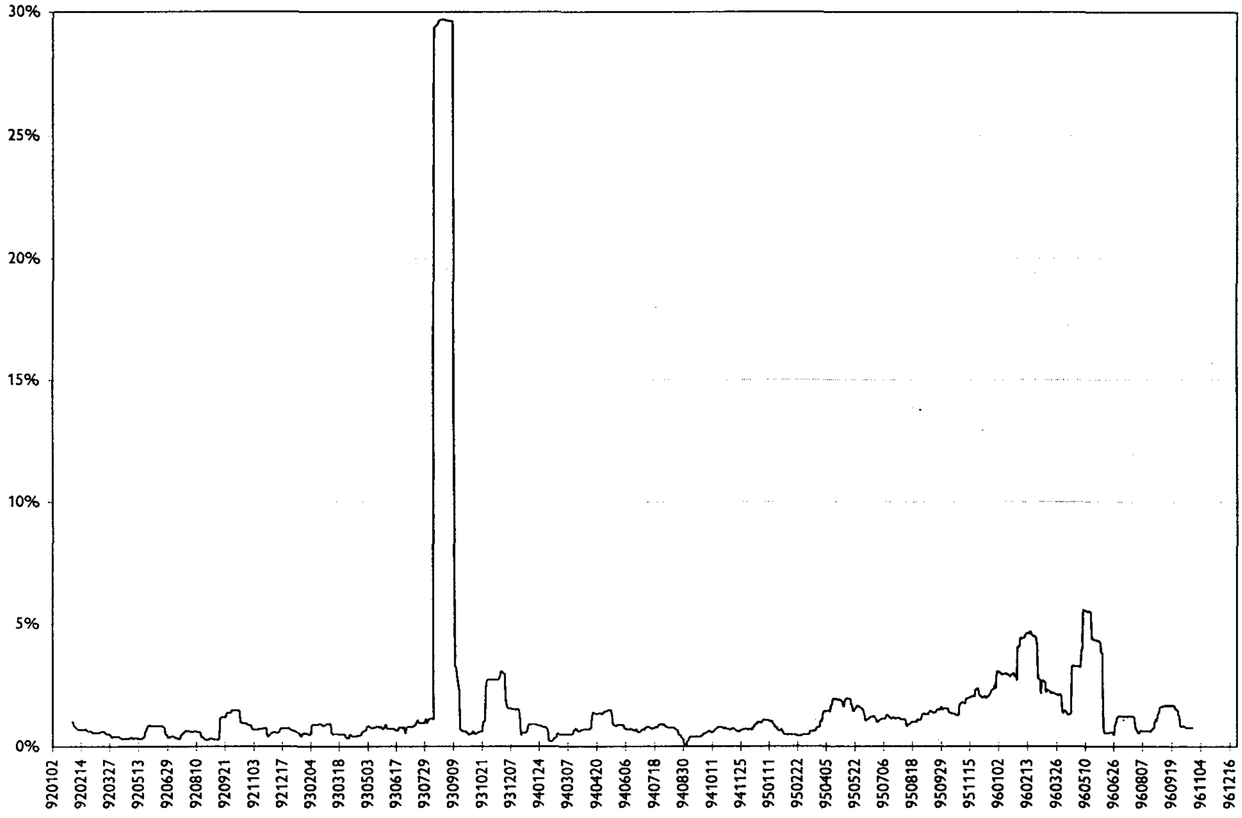


Chart 5
Austrian and German discount rates
1992 - October 1996

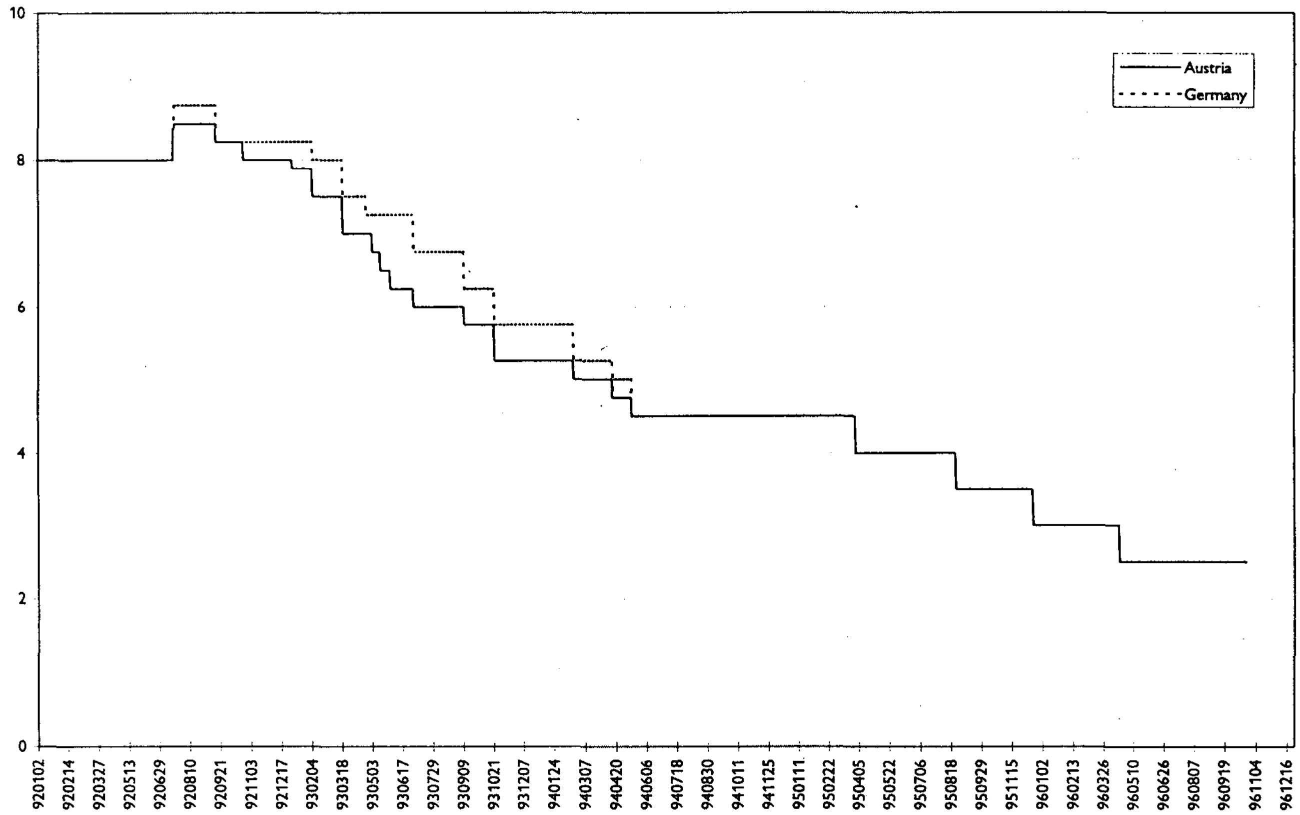
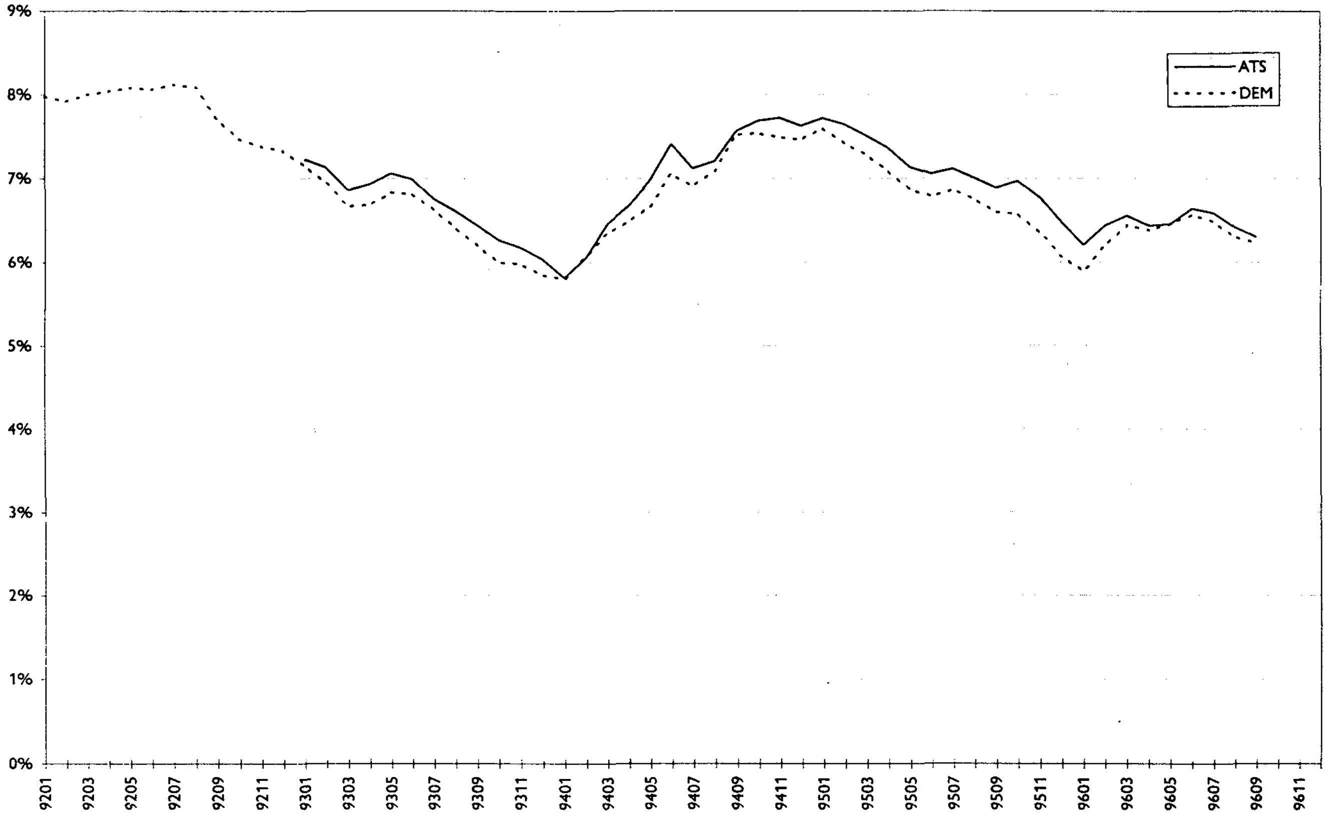


Chart 6
Austrian and German long-term interest rates



Implementing US monetary policy with low reserve requirements

Paul Bennett, Spence Hilton and Brian Madigan[1]

Introduction

Reserve requirements in the United States have fallen to very low levels and are becoming less of a binding constraint on the amount of balances banks maintain in their Federal Reserve accounts. Most recently, so-called sweep account arrangements, which automatically shift customer funds out of reservable liabilities at the end of a business day, have been behind the trend toward lower required reserve balances. A few years ago, US banks' use of Federal Reserve discount facilities for meeting temporary liquidity needs declined noticeably, a situation that persists. This set of circumstances raises issues about potential volatility in short-term dollar interest rates.

1. Background: structures of reserve requirements and reserve accounts

Reserve requirements are computed for banks and other depository institutions as a percent of certain deposit liabilities. For large banks, reserve ratio requirements currently equal ten percent of "transaction" deposits (i.e. demand deposit and checking accounts) at the margin.[2] The Federal Reserve collects information on banks' deposits for two-week holding periods, and banks must hold the corresponding amount of reserves contemporaneously.[3]

Figure 1 shows the structure of bank reserves and the balances banks keep in their accounts at the Federal Reserve. Reserve requirements may be satisfied with a combination of vault cash and Fed account balances. As the chart shows, nearly two-thirds of reserve requirements in the middle of 1996 were fulfilled with vault cash, and the remainder with reserve balances.

The account balances also include excess reserves (i.e. reserves in excess of requirements), as well as required clearing balances. The latter are balances that banks have contracted to maintain and on which they receive implicit interest credits that may be used to pay for Federal Reserve services such as check clearing, money transfers, or securities settlements. Required clearing balances are not included in the calculation of reserves *per se.* But because banks commit themselves in advance to holding these minimum clearing balance levels, during a reserve maintenance period they function analogously to reserve requirements.

All reserve requirements and account balance figures pertain to end-of-day amounts; during the day the banks may use the funds freely for transactions. Thus, when a bank's reserve requirements are met completely by vault cash, it typically will still choose to hold some Fed account balances for transactions purposes during the day, and at the end of the day in the form of clearing

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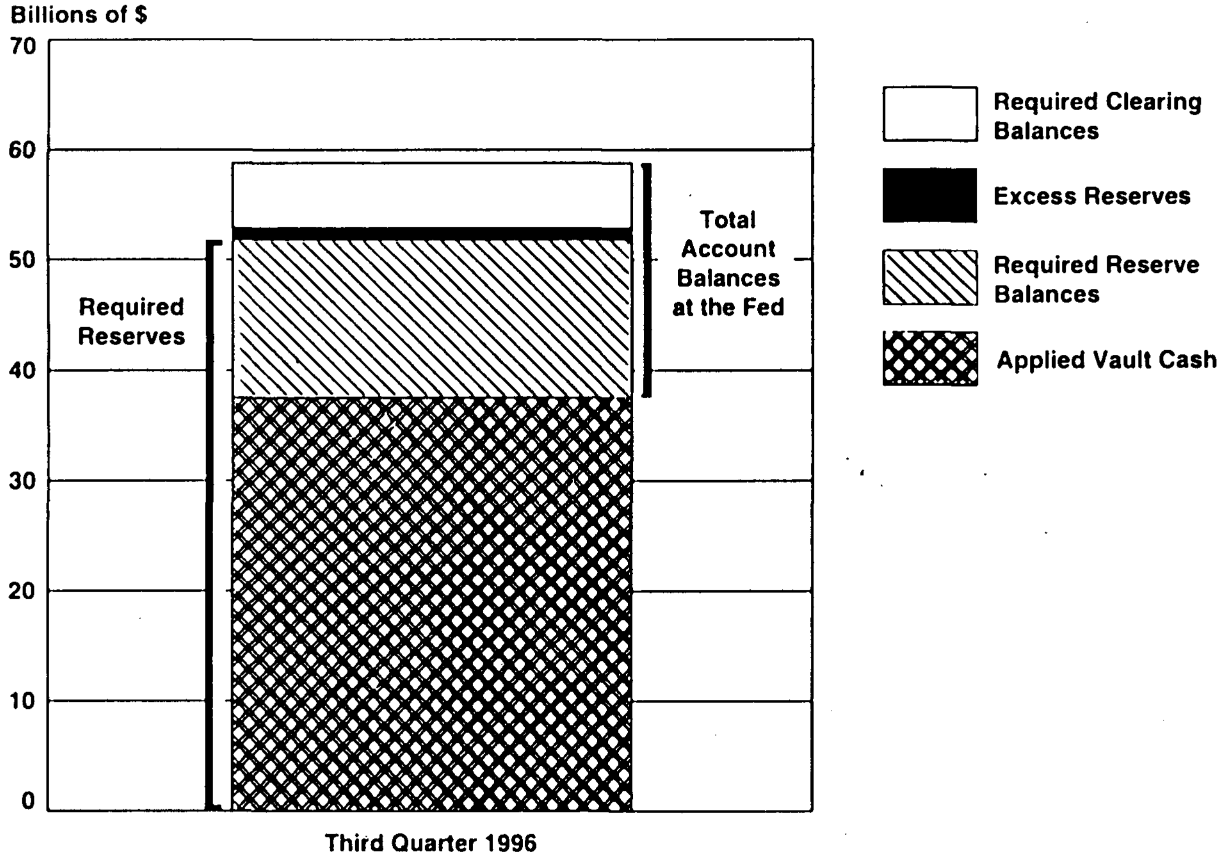
[2] This is a simplified explanation of current reserve requirements; more detail is shown in Figure 2 in this paper. See also the *Federal Reserve Bulletin*, Table 1.15, "Reserve Requirements of Depository Institutions."

[3] More precisely, reserve balance requirements for a given two-week reserve maintenance period are based upon deposits during the corresponding two-week period that ends two days earlier. Vault cash is applied against reserve requirements with a two-week lag.

balances or excess reserves. In addition, most institutions are permitted to run overdrafts during the day. Overnight, however, Fed accounts may not be in overdraft (i.e. overdrafts are penalized), and institutions occasionally borrow from the Federal Reserve's discount window to cover such shortfalls.

Figure 1
Components of reserves and account balances at the Fed



2. Trends in reserve requirements and reserve account balances

Required reserve ratios have been declining over time, and so have required balance holdings at the Fed. As Table 1 reflects, the ratio requirements on time deposits (including large certificates of deposit and net eurodollar liabilities) were set to zero near the end of 1990. These requirements on large deposits had made bank lending less competitive with other wholesale sources of funds such as commercial paper. Remaining requirements are against transaction accounts, which typically pay zero or low rates of interest and have high turnover velocities. In April 1992 the reserve ratio requirement for transactions deposits was reduced from 12 to 10%.

In dollar terms, reserves have been on a pronounced downward trend since 1993 (Figure 2). Nevertheless, vault cash applied against reserve requirements has continued to rise, apparently reflecting the growth in automatic teller machines. Accordingly, the portion of the requirement that must be fulfilled with balances in banks' Federal Reserve accounts has been squeezed down between the lower total requirements and the growing vault cash. Since the late 1980s banks have increased the amounts of clearing balances they commit to hold, in order to earn implicit interest on balances in excess of their requirements. Nevertheless, total account balances, including required clearing balances, have declined for the past three years.

Table 1
Reserves requirements of depository institutions

1976[1]		1986[2]		1996[3]	
Type of deposits	Requirement (% of deposits)	Type of deposits	Requirement (% of deposits)	Type of deposits	Requirement (% of deposits)
Net demand		**Net transaction accounts**		**Net transaction accounts**	
$0 - 2 million	7.5%	$0 - 31.7 million	3%	$0 - 52 million	3%
$2 - 10 million	10	More than $31.7 million	12	More than $52 million	10
$10 - 100 million	12				
$100 - 400 million	13	**Non-personal time deposits**			
Over $400 million	16.5				
		Less than 15 years	3		
Time and Savings		**Eurocurrency liabilities**			
Savings	3				
		All types	3		
Time					
$0 - 5 million by maturity					
30 - 179 days	3				
180 days to 4 years	2.5				
4 years or more	1				
Over $5 million by maturity					
30 - 179 days	6				
180 days to 4 years	2.5				
4 years or more	1				

1 As of December 1976. 2 As of December 1986. 3 As of August 1996.

These trends have affected both small and large banks (Figures 3 and 4).[4] The clearest difference between the two categories is in their holdings of excess reserves. Historically, many small commercial banks and other depository institutions have fulfilled their reserve requirements entirely by vault cash, and, therefore, such institutions have held higher amounts of excess reserves and clearing balances.[5] Large banks, by contrast, have kept excess reserves at very low levels.

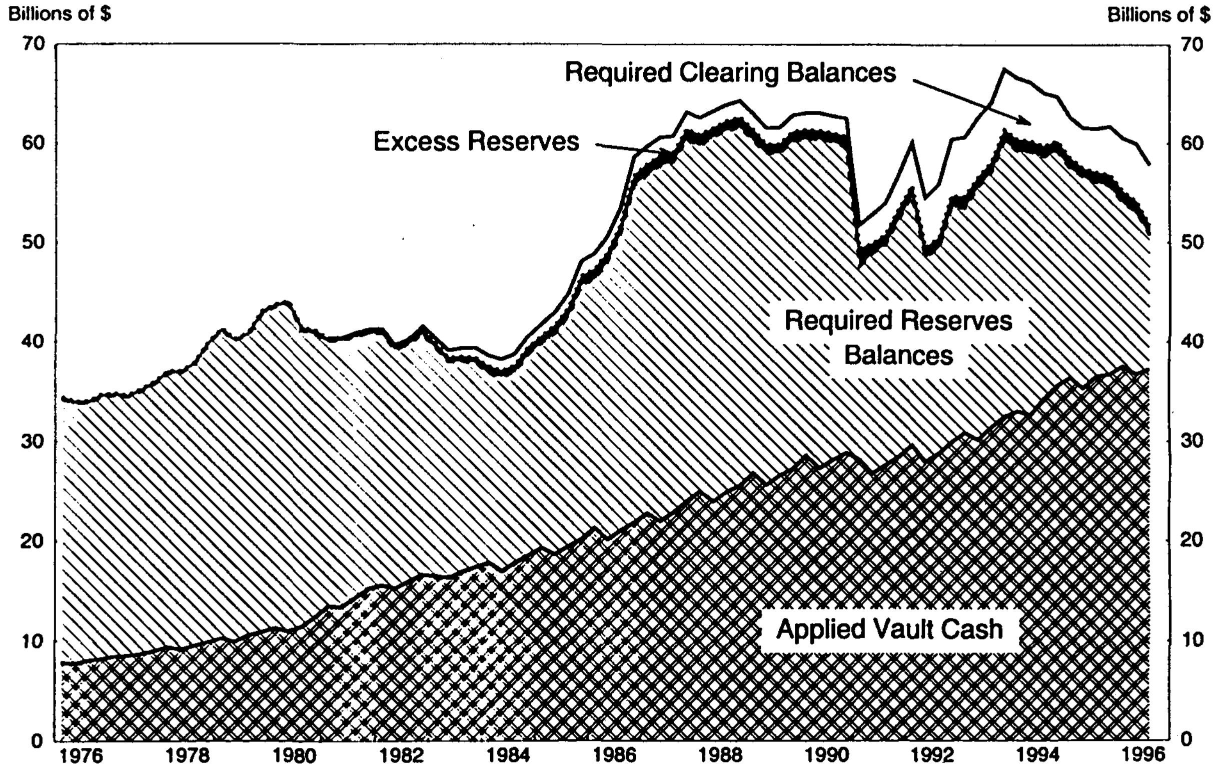
Another difference between large and small banks has been in the pattern of their usage of required clearing balances. While the use of clearing balances has increased on the part of smaller banks, among large banks the rise has been proportionately more striking. Prior to 1990 large banks held only very small amounts of these clearing balances but increased the amounts to over $3 billion by the middle of 1993. Since the credits earned on clearing balances are useful only to pay for Federal

4 The "large" category includes a group of approximately 140 large commercial banks and large thrift institutions. The "small" category contains all other depository institutions.

5 As of the 25th March, 1996, there were 9,095 so-called "non-bound" depository institutions, defined as those with vault cash equal to or greater than their reserve requirements; another 3,141 institutions needed to hold positive reserve account balances to meet their requirements.

Reserve service charges, however, the growth of such balances is intrinsically limited. Since 1993, clearing balance levels for both large and small banks have gone down and come back up, but not increased on a net basis.

Figure 2
Components of reserves and account balances at the Fed



As Table 2 illustrates, reserve requirements are beginning to bind less. Through the middle of 1993, virtually all the larger banks were "bound" institutions, i.e. they needed to hold balances at the Fed to complete their reserve requirements. "Non-bound" large banks – large banks meeting all their requirements with vault cash and thus having no required reserve balances in their Fed accounts – were a rarity. After 1993, however, this changed, due largely to the growth of sweep account, as described below. By the 3rd quarter 1996, large banks with required reserves totaling $5.7 billion had become unbound. As Table 2 shows, the required reserve balances at the Fed for the large banks category had fallen by the 3rd quarter 1996 to $7.5 billion, less than half its 1990 level. Required balances at the small banks also fell, only slightly less dramatically.

Figure 3
Components of reserves and account balances held by small sized institutions

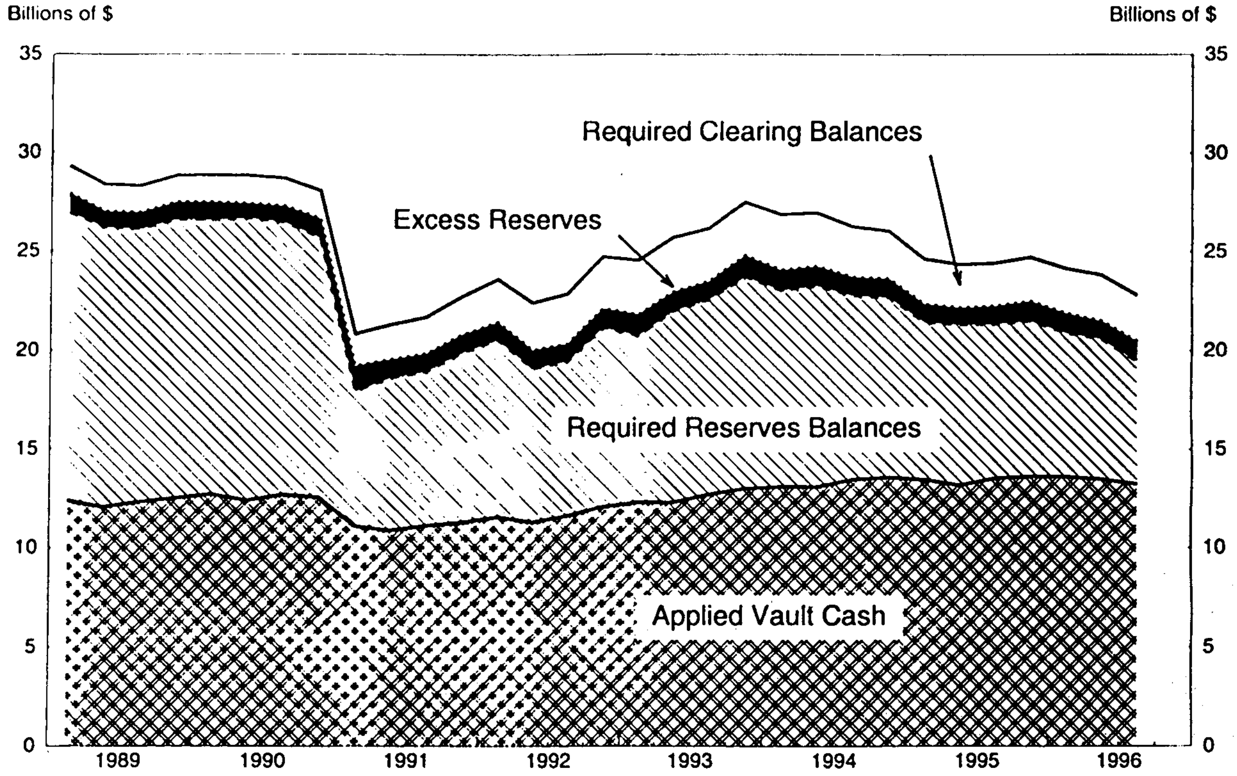


Figure 4
Components of reserves and account balances held by large sized institutions

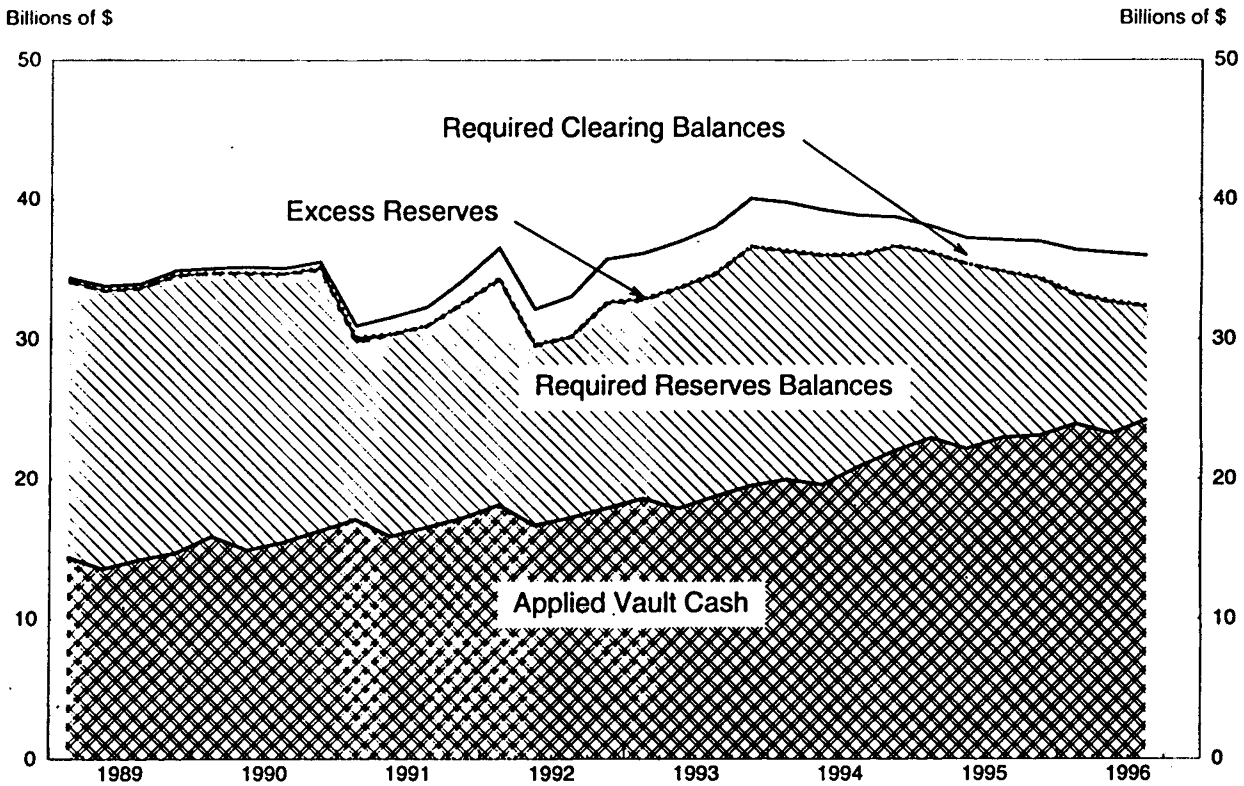


Table 2
Reserve positions of small and large depository institutions
Billions of US dollars

	Total			Bound[1]			Non-bound[1]		
	1990 Q3	1993 Q3	1996 Q3	1990 Q3	1993 Q3	1996 Q3	1990 Q3	1993 Q3	1996 Q3
Required reserves									
Large banks	34.7	34.5	31.5	34.5	34.4	25.9	0.2	0.1	5.6
Small banks	25.4	22.7	19.2	22.1	19.2	13.5	3.3	3.5	5.7
Applied vault cash									
Large banks	15.4	18.7	24.0	15.2	18.6	18.4	0.2	0.1	5.6
Small banks	12.7	12.8	13.1	9.4	9.3	7.4	3.3	3.5	5.7
Required reserve balances[2]									
Large banks	19.3	15.8	7.5	19.3	15.8	7.5	0	0	0
Small banks	12.7	9.9	6.1	12.7	9.9	6.1	0	0	0

Note: "Banks" here refer to commercial banks and thrift institutions. See also footnote 3 in the text regarding the size breakout.

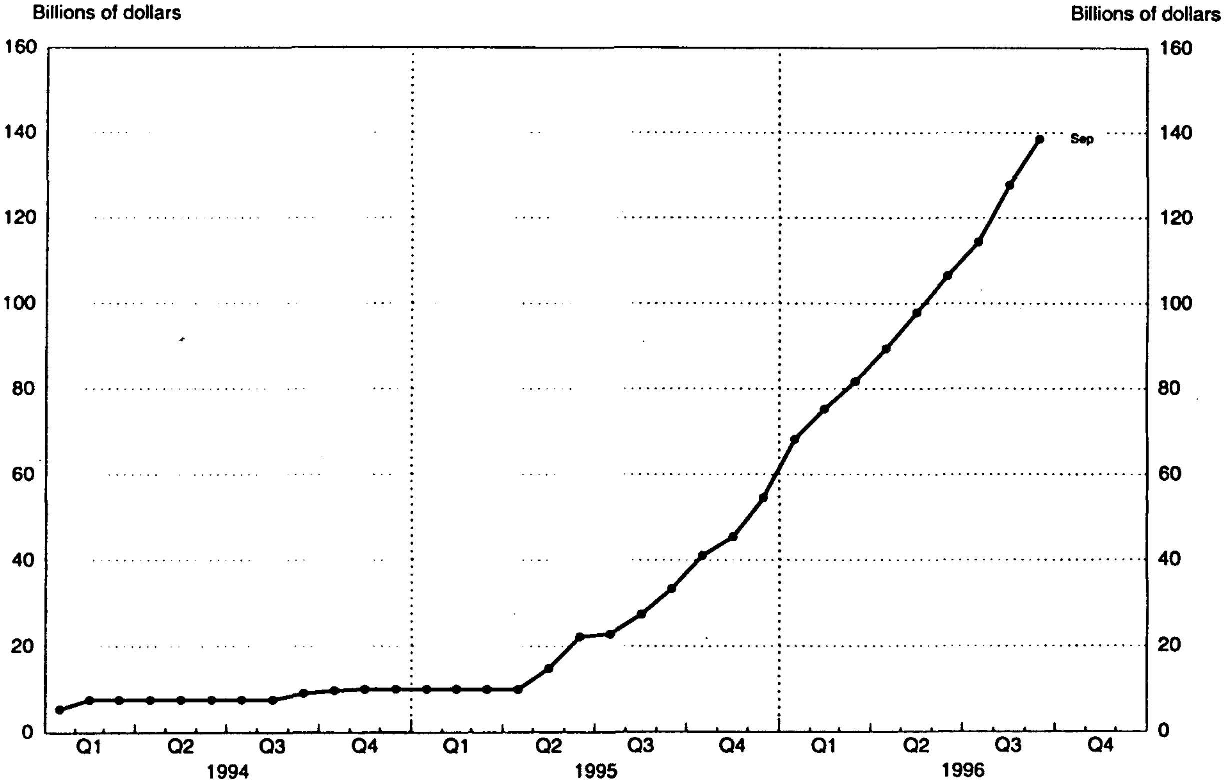
[1] "Bound" institutions are those for whom their reserve requirements exceed their vault cash and, therefore, represent a requirement applying to their Federal Reserve account balances. "Non-bound" institutions have vault cash holdings equal to or exceeding their reserve requirements, and hence have "applied vault cash" exactly equal to their reserve requirements. [2] Excludes required clearing balances.

3. Sweep accounts

While the lowering of requirements on wholesale funding sources had a major impact on required reserves in 1990-91, in the past three years another important factor has emerged in the form of retail "sweep" account arrangements. Sweep arrangements move funds out of transactions accounts at the end of day, to be held overnight in savings accounts that incur no reserve requirements. Depending on the specifics of the arrangements, funds may potentially be swept on a daily basis or over weekends and holidays. The depositor retains the ability to fully utilize the account balances to make payments or withdrawals, yet the bank lowers its reserve requirement. In varying forms, sweep arrangements have existed for business depositors since the 1970s, but the rapidly growing application to retail accounts is new.

While precise figures are not available, estimates indicate that the effect of the recent growth in sweep accounts has been very substantial. The Federal Reserve does not collect regular statistics on the outstanding amounts of sweep arrangements. But since 1994 we have kept track of when such arrangements have been implemented at banks, and we have also kept track of the amounts of deposits affected at the start of each bank's program. Cumulating these initial amounts gives at least a rough indication of their growth, although the methodology fails to account for changes in swept balances after programs are underway. Figure 5 plots the cumulative initial sweep account balances.

Figure 5
Sweeps of retail transaction deposits into MMDAs*



* Monthly figures are the accumulated estimates of total transaction account balances initially swept into MMDAs owing to the introduction of new sweep programs.

As of the 3rd quarter 1996, the cumulated initial balances method implies that nearly \$130 billion of transactions balances that would otherwise incur reserve requirements were being swept into savings accounts; moreover, the amount of sweeps being implemented was continuing to grow very rapidly. At current reserve ratio requirements this implies that the spread of sweeps has reduced required reserves by nearly \$13 billion since the beginning of 1994. By comparison, during the three-year period ending in mid-1996, required reserve balances fell by \$11.2 billion (Table 3); thus sweep arrangements appear to be a key factor accounting for the recent drop in required reserve balances.

Table 3
Composition of federal reserves accounts
Billions of US dollars

	1990 Q3	1993 Q3	1996 Q3
Sum of account balances plus applied vault cash	62.8	64.2	58.8
Applied vault cash	28.1	31.4	37.2
Account balances at the Fed	34.7	32.8	21.6
Required reserve balances	32.0	25.8	14.6
Required clearing balances	1.8	6.0	6.0
Subtotal: required balances	*33.8*	*31.8*	*20.6*
Excess reserves	0.9	1.0	1.0

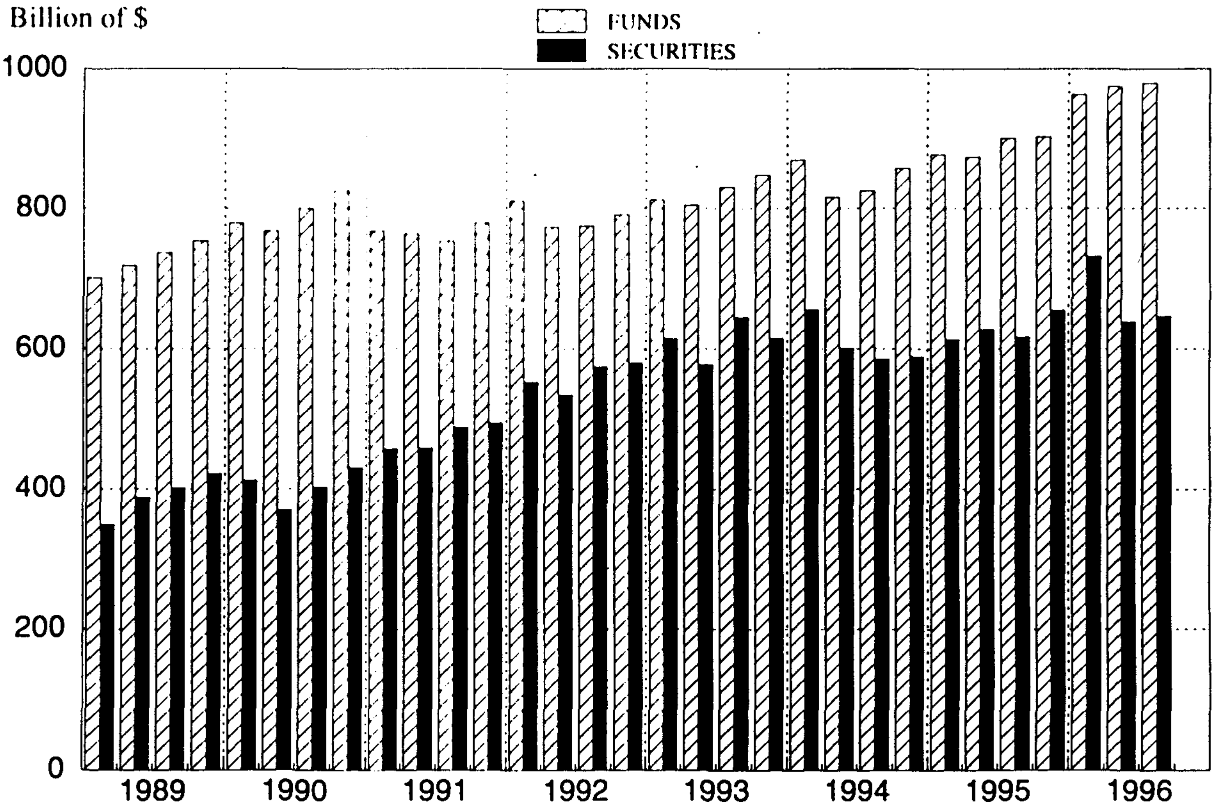
An $11.2 billion drop may appear small relative to the overall size of the money markets or bank liabilities, but operationally it is highly significant because of its size relative to the total amounts of reserve account balances. By the 3rd quarter 1996 the total of required reserve and clearing balances was $20.6 billion, and this figure has been continuing to decline. As required balances have fallen, excess reserves have remained in the neighborhood of $1 billion, consistent with requirements remaining binding at many institutions. Nevertheless, if such large declines in required reserves were to continue, in principle they could cease to bind at many more banks, barring other developments.

4. Payments-related demand for account balances

Reserve account balances held at the end of the day are counted towards meeting reserve requirements. But credits and debits to banks' reserve accounts are also used extensively throughout the day as a means of final settlement for business and banking transactions, creating an additional source of demand for reserve balances. Partly for this reason, reserve pressures often arise on days when transactions flows are particularly heavy, even when reserve balances appear more than adequate for banks to meet their reserve requirements.

Reserve balance requirements will be binding as long as they exceed the amount of balances banks would choose to hold for transactions purposes. The latter amount, in principle, may change for several reasons, such as transactions costs, the cost of overdrafting the account during or at the end of the day, and the uncertainty of the flow of debits and credits to the account during the day. In the presence of reserve requirements, the balances banks would have chosen to hold in their absence are unobservable, but some inferences, nonetheless, can be drawn concerning the basic trends in the balances needed to support payments activities.

Figure 6
Average daily value of Fedwire transfers

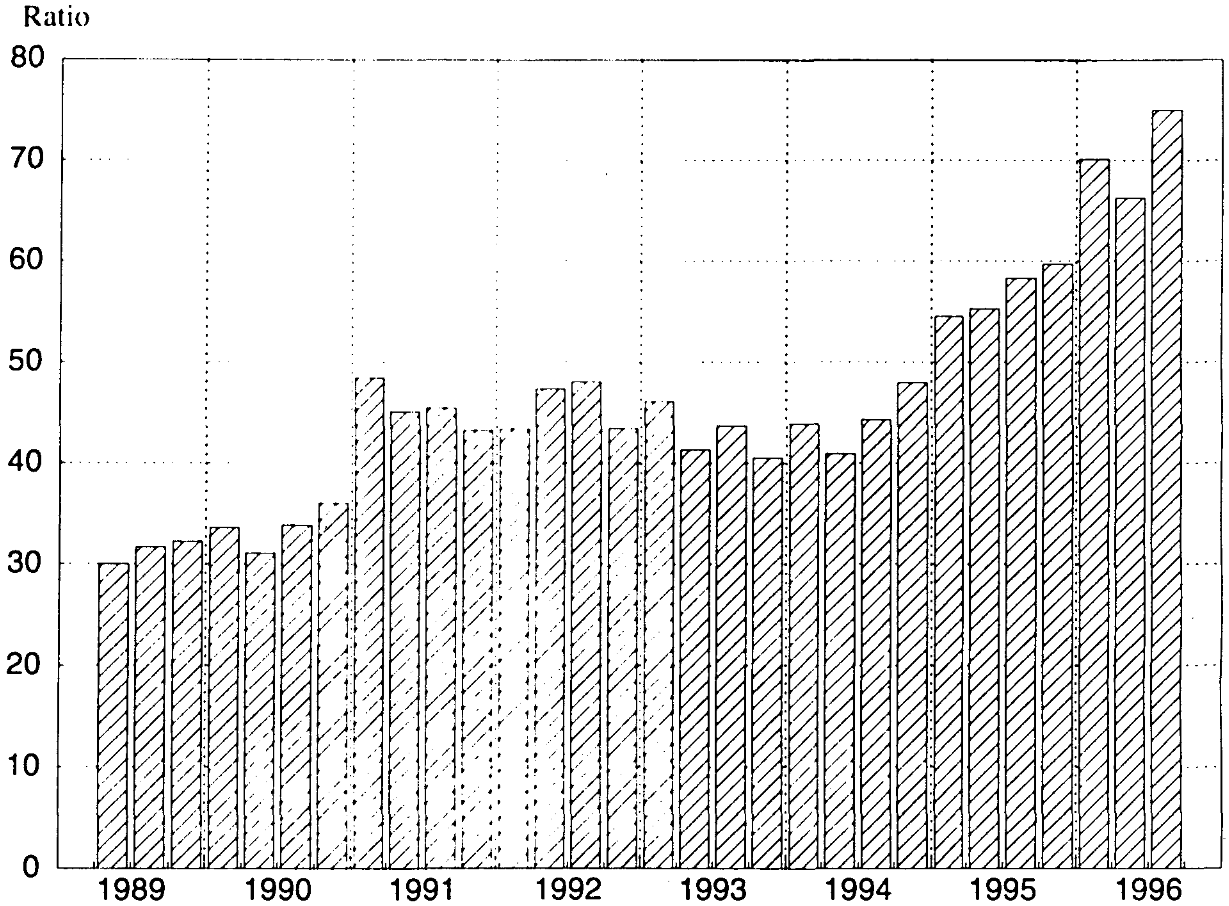


For the most part, the trends have been in the direction of lowering the amount of reserves that banks need to carry out a given flow of transactions. One factor allowing this has been banks' improved ability to monitor their reserve account positions during the day. For example, in the first part of the 1980s the Federal Reserve made available computer screens to banks allowing them to track the effects of money and securities transfers on their Fed accounts, but these did not become fully effective as account balance monitoring tools until the early 1990s when virtually all debits and credits began to be entered into the real-time intraday totals transmitted to banks. This information makes it possible for banks to manage their accounts better and to control end-of-day balances more accurately.

Indeed, as Figure 6 shows, the dollar volume of large payments running through Federal Reserve accounts has continued to grow, albeit modestly in recent years, even as total reserve balances have fallen, placing greater demands on the remaining balances. This is also illustrated in Figure 7, which plots the ratio of dollar transactions to aggregate end-of-day balances. On balance, the marked increase in transactions flows relative to end-of-day balances since 1993 suggests that banks have been closing the gap between the balances required by regulation and their demands for balances to carry out payments.

Figure 7

Ratio of total payments to reserve account balances*



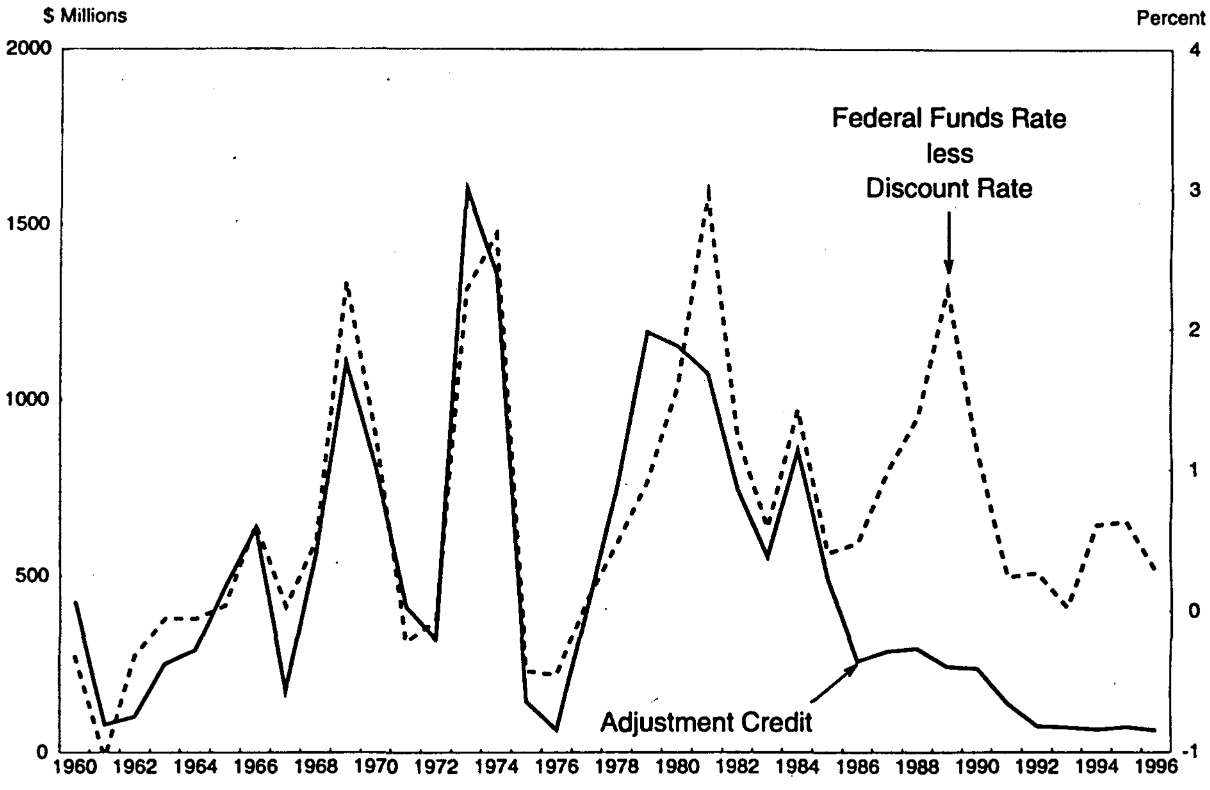
* Average daily Fedwire funds and securities-related transfers in dollars, divided by average daily end-of-day balances at the Fed.

5. Federal reserve credit

In recent years, banks have appeared less willing to borrow from the Federal Reserve's discount window.[6] Typical reasons for borrowing are to offset temporary shortfalls in reserve accounts, as when funds are badly distributed in the market, or when computer problems at a bank or its counterparties create imbalances. Although the interest rate charged on discount loans is usually set below rates in the interbank market, the Federal Reserve rations the frequency of borrowings and requires collateral for loans. Banks are encouraged to actively seek funds in the market before coming to the Fed. Historically, the amount of borrowing has been systematically related to the spread between the discount rate and the federal funds rate, both because a high federal funds rate may reflect a tight, difficult market and because of strategic behavior by banks seeking to lower funding costs.

Since the mid 1980s, the historical relationship between borrowings and the spread has broken down, as is clear in Figure 8. An explanation in the 1980s was that banks feared that borrowing would identify them as having funding problems, at a time when bank failures were high. The continuation of this hesitancy to make use of the discount window is not completely understood, but it may be that some of the stigma associated with discount borrowing has not entirely gone.[7]

Figure 8
Adjustment borrowing and the spread of the federal funds rate over the discount rate



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[6] In addition to discount window credit, which takes the form of 24-hour loans, the Federal Reserve also extends credit in the form of intraday overdrafts. In the latter 1980s and early 1990s a series of policies were implemented placing caps on the amount of intraday credit to depository institutions and implementing minute-by-minute pricing of account overdrafts. The net effect of the policies has been to discourage overdrafts during the day. In principle, this might also reduce the incidence of end-of-day overdrafts or borrowings, although little hard evidence exists on the effects of lower intraday overdrafts on end-of-day accounts. It should also be noted that the Federal Reserve imposes a penalty rate on overnight overdrafts not funded with discount borrowings, such as might occur when a bank receives an unexpected debit to its account after personnel authorized to borrow have gone home for the night.

[7] Thirty-four of fifty respondents to the Federal Reserve's May 1996 Survey of Senior Loan Officers indicated that such concerns continued to play at least some role in their decisions to seek discount window credit.

In principle, other factors equal, a hesitancy to borrow from the discount window would increase the amount of end-of-day account balances banks would target, in order to reduce the likelihood of needing to borrow. Similarly, in principle, Federal Reserve policies to limit account overdrafts during the day might increase expected end-of-day account balances and reduce the probability of overnight discount window borrowings. In practice, however, the decline in reserve requirements and the improved account balance monitoring capabilities have been more dominant factors, reducing end-of-day balances.[8]

Nevertheless, the hesitancy of banks to borrow from the discount window might become more important if reserves continue to fall dramatically, for such borrowings buffer unanticipated shocks to account balances. If banks hesitate to borrow from the Fed, then their need to borrow from market sources on a given day might become more urgent, possibly affecting overnight interest rates. Certainly, on the final day of reserve holding periods it has been commonplace for there to be relatively large swings in the federal funds rate.

6. Potential volatility

Low reserve requirements lower the intertemporal substitutibility of reserve account balances within a maintenance period, possibly contributing to increased volatility in overnight interest rates for immediately available reserve balances. As average reserve account balances fall, the likelihood increases that random variations in the flow of payments would push account balances into negative territory on a given day. Unlike shortfalls from the level of required reserves, which can be made up during the remainder of a reserve maintenance period, a reserve balance shortfall must be made up by the end of a business day. A bank unexpectedly in overdraft near the end of a day would then have to quickly seek funds in the market.

Conversely, low reserve requirements also reduce the willingness of banks to accept large surplus reserve positions at the end of any day. A bank trying to offset a large surplus position on one day by holding lower balances over the remaining days of a reserve accounting period faces an increased risk of incurring an end-of-day overdraft when reserve levels are low. Not only do lower required reserve balances reduce the ability of an individual institution to absorb unexpected reserve surpluses or deficiencies from its level of requirements, but at the same time – and for the same reasons – other institutions have reduced flexibility to act as counterparties to those attempting to make such adjustments.

This can lead to volatility in the federal funds rate. If a bank with a reserve shortfall that must be covered is able to easily identify institutions with offsetting surplus positions, then the funding markets should be able to clear without increased pressure on interest rates. However, if there are inefficiencies in identifying banks with offsetting reserve positions, which can easily arise when there are a large number of active participants in the reserve markets, then there is a strong potential for greater volatility in rates. Such volatility is particularly possible late in the day, when liquidity in funding markets often decreases.

Increased volatility also can result from the greater unpredictability of the aggregate demand for reserve balances when required reserves are low. As noted above, when required reserve balances are low, banks' daily net demands in the funds market are determined more by their day-to-day transactions needs, which in turn depend on a variety of market and payment system factors. Some of these factors, such as settlements for Treasury auctions, other sizable government payments, and coupon and principal payments on private securities, can be identified in advance. Others, however, are idiosyncratic and difficult to anticipate. Consequently, the Federal Reserve's ability to accommodate aggregate fluctuations in day-to-day transactions needs has its limits. Resulting

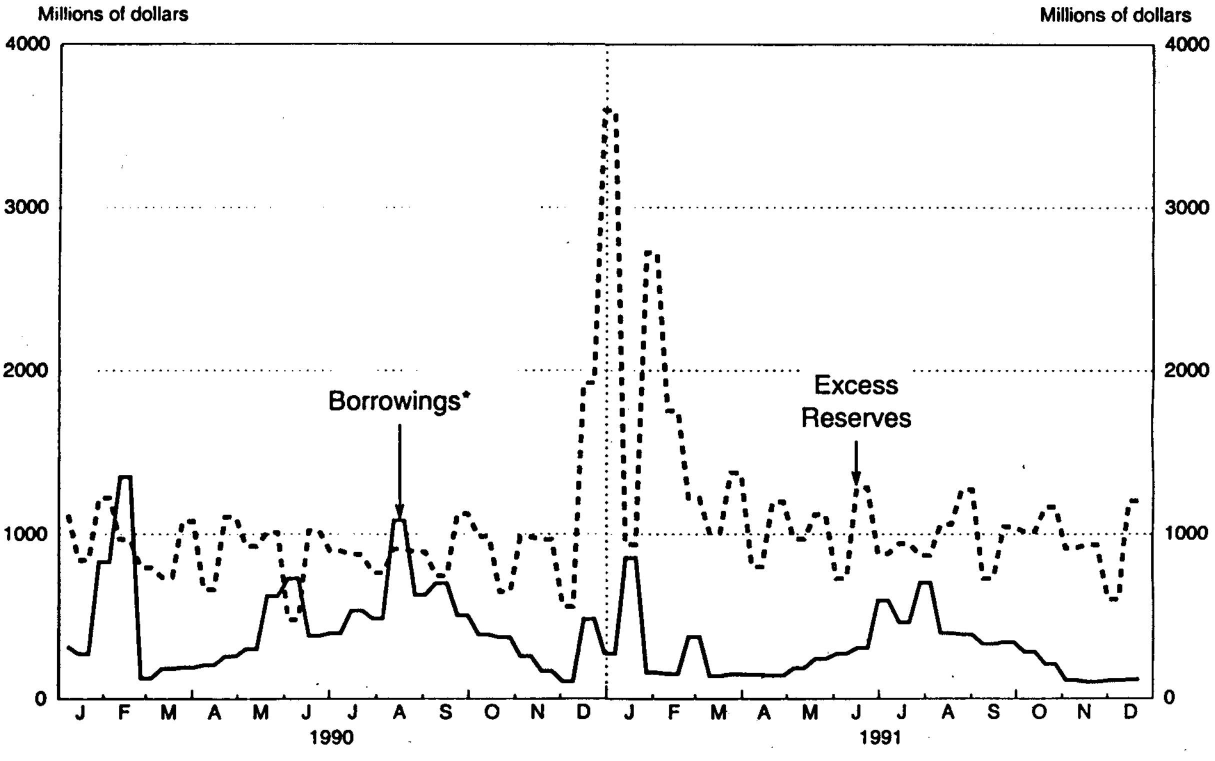
8 Respondents to the May 1996 Senior Financial Officer Survey confirmed this hypothesis.

mismatches between reserve demand and supply – particularly in the context of an unwillingness to borrow from the discount window – may add to volatility in the federal funds rate when required reserve balances are low.

7. The 1990-91 episode

Concern about potential market rate volatility stems also from the experience at the end of 1990 and beginning of 1991. At that time, reserve ratio requirements on wholesale funding sources were dropped. Furthermore, there were some concerns about the creditworthiness of some counterparties in the market. Finally, it was the end of the fiscal year for many banks and other companies, creating additional market activity. Figure 9 plots excess and borrowed reserves over this period. The sudden spike in excess reserves at the end of 1990 reflected an immediate but relatively short-lived response to the drop in reserve requirements at that time.

Figure 9
Bank reserve positions
Average of daily figures for reserve averaging period

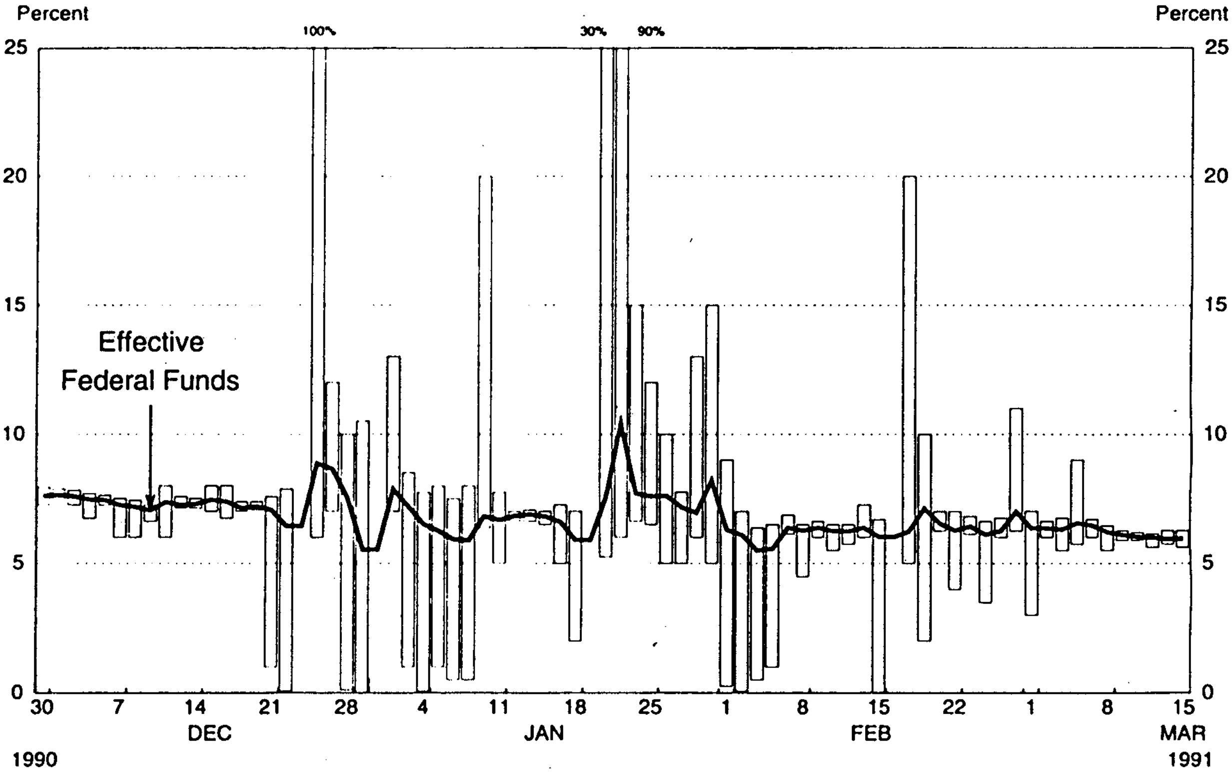


* Excludes extended credit borrowing.

These volatile market conditions were reflected in the transactions prices paid for federal funds. Figure 10 plots the intraday ranges of federal funds rates recorded each day between December 1990 and March 1991. On certain days, transactions prices ranged from near zero to levels as high as one hundred percent. Banks with excess funds in certain cases almost had to give them away, while banks needing funds had to pay very high rates at times.

Fortunately, the situation appeared to have limited economic consequence and was resolved quickly. Figure 11 plots the daily average federal funds rate against three-month libor and US treasury bill rates. Possibly also reflecting the volatility in the overnight federal funds market, the libor rate was somewhat volatile and high relative to treasury rates. T-bill rates appear to have been unaffected and may even have benefited from some "flight-to-safety" during those days. The average daily federal funds rates did tend to "spike" on Wednesdays at the end of reserve maintenance periods, but overall the volatility was contained.

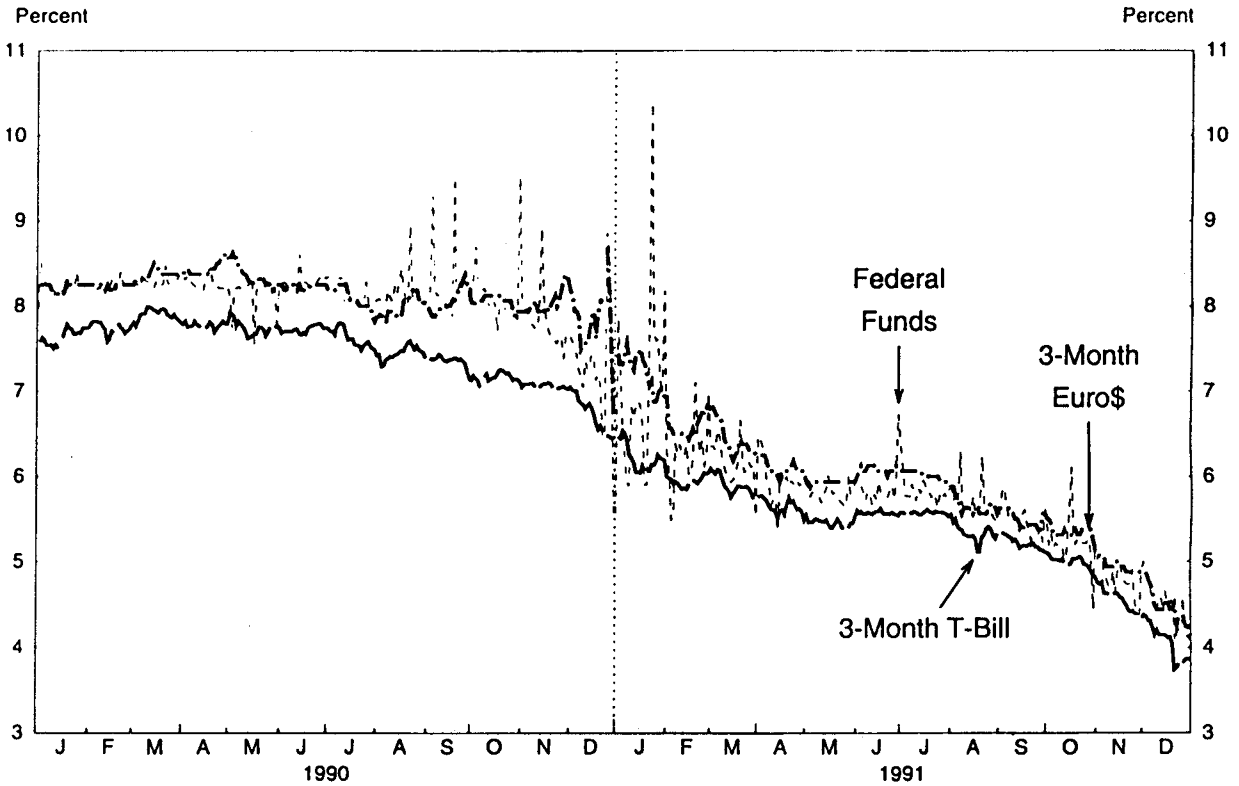
Figure 10
Bank reserve positions: daily high and low federal funds rates
1990-91 federal funds volatility



Several factors helped alleviate the situation. Because the Federal Reserve was easing monetary policy by reducing short-term interest rates in order to cushion weakness in the economy, growth of money and hence required reserves was relatively rapid, helping to lift required reserve balances above critically low levels. Moreover, more banks opened required clearing balances, and the seasonal trough in required reserves balances passed. In addition, banks may have become more adept at managing their reserve positions with low required balances. As a result of these factors, volatility of the federal funds rate soon returned to normal.

Based on this one episode, it is not possible to sort out the relative contributions of the reserve requirement cut, the end-of-period environment, and other special factors. But it demonstrates the possibility that a low reserve requirement environment may contribute to substantial intraday volatility. Fortunately, the volatility apparently had only moderate effect on other short-term rates and little or none on the effectiveness of monetary policy.

Figure 11
Average federal funds, T-bill and 3-month eurodollar rates



Conclusion

The 1990-91 experience demonstrated the possibility of problems in conducting monetary policy arising in a low-reserves environment. But other factors were at work, and it is difficult to sort out how much was due to transitional and year-end factors. Nevertheless, a reasoned analysis suggests the possibility of unstable overnight interest rates in a low-reserve-requirement environment, particularly if sweep accounts continue to grow rapidly. It remains unclear how important these issues might become from a practical viewpoint of influencing the broader range of market interest rates and liquidity conditions. Whether any procedures have to be reexamined may become more apparent if the trend toward lower reserve requirements continues.

French monetary policy: some implementation issues

Christian Pfister[1]

Introduction

As a consequence of the sweeping movement of financial deregulation, the instruments and procedures of French monetary policy and their financial environment underwent drastic changes in the mid-eighties. These changes have already been described in depth.[2] They included:

- the demise of direct quantitative control and a substantial decrease in the share of subsidised credit in overall banking credit;
- the modernisation of the management of public debt through the creation of a range of negotiable instruments accessible to all investors, covering all maturities and issued through competitive tenders;
- the reform of the money market through the creation of two compartments. One is the interbank market, which is only open to financial institutions and on which central bank operations are focused. The other is open to all economic agents; instruments such as certificates of deposit, commercial paper and Treasury bills are traded on it. Another aspect of the reform of the money market was improved security through the promotion of repurchase transactions with delivery of securities;[3]
- the creation of financial derivatives markets, the development of short-term mutual funds that gave non-financial agents easy access to money market-related remuneration for their liquid assets and the removal of all capital controls as part of the move towards the creation of the Single European Market; and
- the reform of the Banque de France's money market intervention techniques. The central bank continues to use two kinds of repurchase agreements that normally define the upper and lower limits for money market rates: the first kind of repurchase agreement – repurchase tenders – is conducted at the discretion of the central bank; it constitutes the lower limit for money market rates and is used to supply the bulk of reserves; the second kind of repurchase agreement – the five-to-ten-day repurchase window – is a standing facility that provides the upper limit. However, in line with the reform of the money market, from 1986 onwards, the Banque de France started to intervene more frequently on the market. This was done even when the short-term money market rates lay between the two official rates referred to above, either through outright transactions or through very-short-term repurchase and withdrawal transactions for fine tuning purposes, without any formal announcements.

This paper concentrates on some of the consequences of these structural changes for the implementation of French monetary policy, and more specifically on the more recent years.

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1 I am grateful to Thierry Grunspan who carried out the econometrics used in this paper, to Pierre Sicsic for valuable methodological comments and to my colleagues in the Capital Markets Division, Elisabeth Pauly, Olivier Cousseran and Yves Nachbaur for their very helpful comments and suggestions. The views expressed are mine and not necessarily those of the Banque de France.

2 See Icard (1994).

3 See De Lapasse (1994) and Paul and Wilhelm (1996).

It appears that the main changes in the tactical approach to monetary policy were not related to changes in the structure of the money markets, even though the greater integration of these markets has broadened the range of operational instruments at the disposal of the central bank and may also have increased the rapidity and intensity of the pass-through between policy rates and other market rates. Rather, the most relevant changes have stemmed from the opening up of the French financial markets. As will be shown in Section 1, the respective roles of the various monetary policy instruments and procedures have evolved towards an increasing reliance on open market operations, and especially fine tuning operations. This change took place in a context where convergence of French economic fundamentals towards price stability, free movement of capital and financial innovation increased the substitutability between domestic and foreign assets and where the stability of the French franc vis-à-vis the most credible currencies participating in the Exchange Rate Mechanism (ERM) was pursued as a way of increasing the credibility of French monetary policy and facilitating the domestic disinflationary process. A tentative assessment of this change in the Banque de France's tactical approach to monetary policy is made in Section 2. The final section offers some remarks concerning the future and a model of the diffusion of changes in the intervention rate to money market rates is estimated and discussed in an Appendix.

1. The changing roles of the various monetary policy instruments and procedures

Against the background of its monetary policy objectives and growing capital mobility, the Banque de France has increasingly come to rely on open market operations, and especially fine tuning, to implement its monetary policy.

1.1 Monetary policy objectives

Since the mid-eighties, French monetary policy has pursued price stability as its final objective using two intermediate objectives one of which is domestic and the other external.

The domestic objective is based on a growth target for a money aggregate, the definition of which has somewhat varied over time – essentially M2 till 1990, M3 thereafter – as a consequence of financial innovation and deregulation. Both factors, and the fact that the external objective is more binding in the short-term conduct of monetary policy, led from 1993 onwards, to the monetary target being assigned a medium-term objective.

Indeed, the external objective of keeping the exchange rate of the franc stable vis-à-vis the most credible currencies – i.e. those that have the lowest yield curves – in the ERM has been the greatest constraint on the use of monetary policy instruments and procedures as inflationary pressures were kept under control, the prospect of European monetary unification approached and capital mobility improved.

1.2 Growing capital mobility

The complete liberalisation of capital movements and the availability in France of a full range of financial instruments, traded on liquid and secure markets, have made French financial markets increasingly sensitive to external developments. As far as the consequences for the use of monetary policy instruments and procedures are concerned, greater capital mobility led to a heightened risk of the relocation of certain financial activities, to efforts to try to "disconnect the domestic impact of monetary policy from its external effects"[4] in situations of tension on the foreign exchange markets, and to the need to create "two-way risk" on the foreign exchange market.

(i) Mainly in order to prevent domestic funds from shifting to Euro-markets, the reserve requirements on time liabilities were eased from 3 to 0.5% in October 1990 and to 0% on time liabilities over one year in December 1991.

(ii) Moreover, as the markets and the central bank have occasionally followed different lines of reasoning,[5] there were situations in which the exchange rate was under pressure and there was a need to shield domestic borrowers as far as possible against higher interest rates. This was achieved temporarily in two ways:

- reserve requirements were lowered on several occasions, by decreasing reserve ratios on sight deposits and passbook savings (in October 1990, January 1991, December 1991 and May 1992) and including vault cash (from October 1990, 75% of vault cash was included and from January 1991, 100%); on one occasion in December 1991, reserve requirements were alleviated as the repurchase tender rate was raised; in the other cases, the repurchase tender rate was kept unchanged and the fall in reserve requirements acted to some extent as a substitute for lower intervention rates; and
- from the second part of 1992, when there was tension on the foreign exchange market, the link between money market rates and the repurchase tender procedure was loosened as the latter rate was kept unchanged and the five-to-ten-day repurchase window was closed and replaced temporarily by an overnight facility to tighten control over the overnight rate. Keeping the repurchase tender rate unchanged also helped to signal that there was no need to change the medium-term orientation of monetary policy (see 2.2).

(iii) Finally, an important measure affecting the operating environment of monetary policy was the widening of the ERM fluctuation bands in August 1993 from ± 2.25% to ± 15%, in order to fight speculative pressures by creating "two-way risk" in the ERM.

The perception among certain market participants that the exchange rate commitment was not credible was probably at the root of the speculative attacks that led to that decision. Also, after the widening of the ERM fluctuation bands, there were expectations that there would be more exchange rate flexibility, in contradiction to the goal set in the original arrangement, the fact that central rates had been kept unchanged as well as the orientation of policies pursued thus far.

As a consequence, in order to dissipate any lingering doubts about the exchange rate commitment, it may be considered that the widening of ERM fluctuation bands increased the need for caution in adjusting money market interest rates towards their "baseline" levels in the wake of speculative attacks. This means that very short-term money market interest rates might have to be more tightly controlled.

1.3 An increasing reliance on open market operations, especially fine tuning operations

The greater use of open market operations, as well as the wider use of repurchase agreements by the central bank, can be seen as a step towards convergence in monetary policy instruments and procedures in EU countries.[6]

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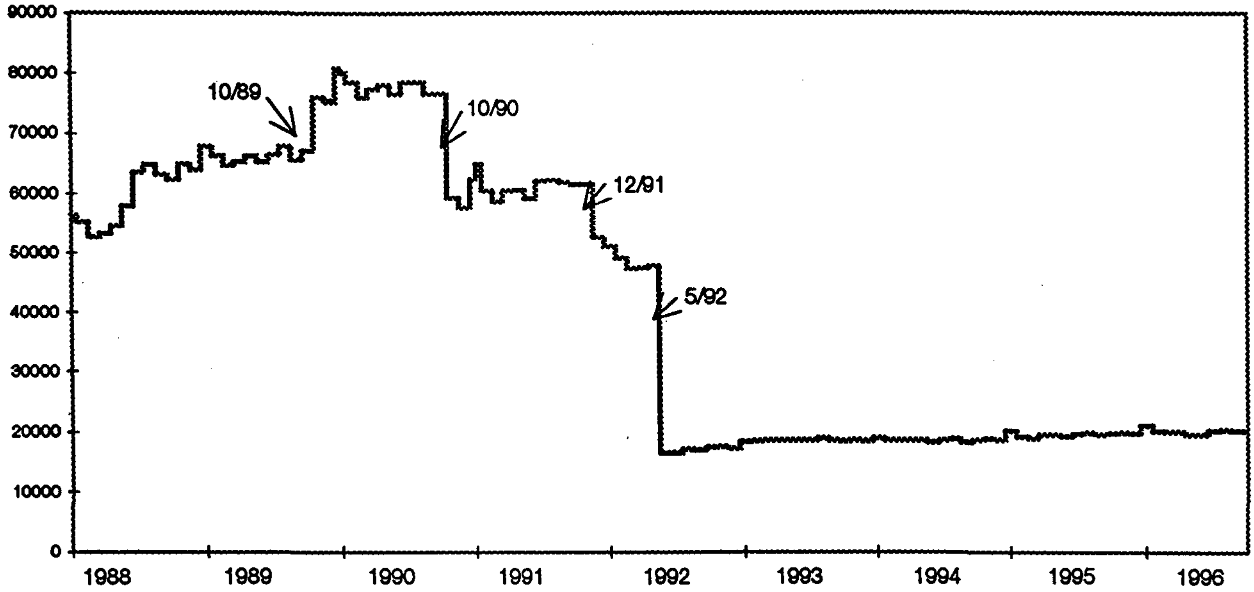
[4] See Icard (1994). It is also worth noting that French private non financial agents were "de facto" protected to a large extent against a rise in short-term interest rates insofar as more than 60% of their debt was referenced on long-term interest rates in 1994. See Grunspan (1995).

[5] See Raymond (1994).

[6] See Aspetsberger (1996).

It is also consistent with a reduced role for reserve requirements that can itself be viewed as a general trend in industrialised countries.[7] In France, as mentioned above, reserve requirements have been lowered drastically since 1990. Today, reserves held with the Banque de France for reserve requirement purposes represent less than 0.1% of GDP, as compared with 1.2% of GDP in 1990 (see Graph 1), and it has been estimated that reserve holdings absorbed only 5% of liquidity shocks in 1994.[8] Moreover, as required reserves are considered to be very close to the level of settlement balances, their stabilising effect on very short-term interest rates has sharply decreased, in spite of averaging provisions over one month.

Graph 1
Reserve requirements*



* Includes vault cash since October 1990.

Since the last reserve requirement reduction, which was decided in May 1992 and which has not been reversed since, open market operations have had to bear the brunt of the Banque de France's money market management. Since 1992, fine-tuning open market operations have been conducted virtually every day, both on overnight and longer maturities.

2. A tentative assessment

Among the main functions of an operational framework for monetary policy, one can distinguish its ability to signal monetary policy intentions, contain the volatility of money market rates and steer these rates.[9] The role performed by open market operations conducted by the Banque de France is first assessed against these three benchmarks[10] and an overall judgement is then made.

7 See Bank of Japan (1995) and Bisignano (1996).

8 See Escrivá and Fagan (1996).

9 See European Monetary Institute (1996). The EMI Report also mentions the roles of the operational target in providing and withdrawing liquidity in the interbank market, helping to control monetary aggregates, allowing adequate information to be extracted from market developments and possibly contributing to the smooth functioning of the payment system.

10 The methodology used is described in the Appendix.

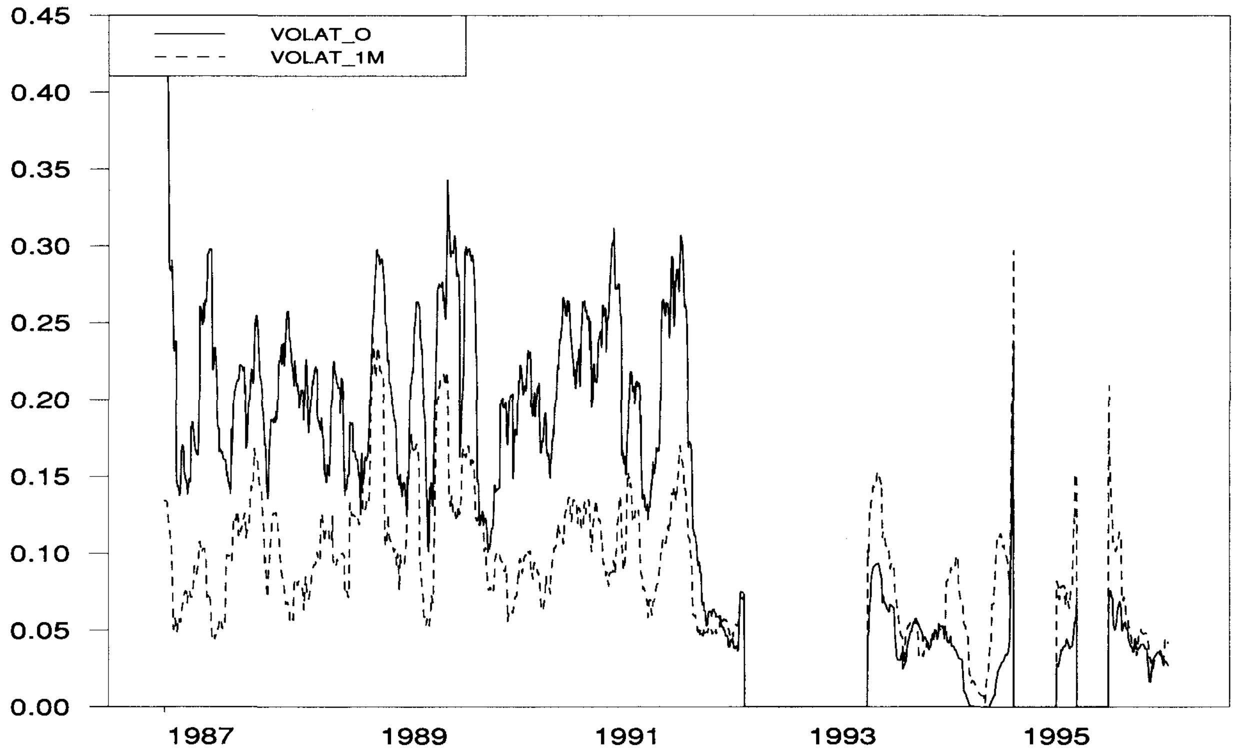
2.1 Volatility of short-term interest rates

As in the research conducted at the EMI,[11] the volatility of short-term interest rates is assessed through the standard deviation of the difference between the official rate at which the bulk of liquidity is provided – the repurchase tender rate – on the one hand, and the overnight rate or the one-month rate on the other, so as to eliminate the effect of the trend in money market rates on the level of volatility.

Graph 2 shows that, after 1992, the lower volatility of the overnight rate has not been accompanied, in normal times,[12] by higher volatility in the one-month rate. In fact, average volatility has declined from 0.20 for the overnight rate and 0.11 for the one-month rate before 1992 to, respectively, 0.05 and 0.07 after 1992.

Graph 2

Volatilities of the overnight and one-month rates



2.2 Signalling the monetary policy stance

Granger causality tests reveal that:

- throughout the period, there is causality between the one-month rate and the overnight rate; this may reflect the accuracy of market expectations;
- until 1992, the repurchase tender, five-to-ten-day window and overnight rates had an influence over the one- and three-month rates; and

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11 See Escrivá and Fagan (1996).

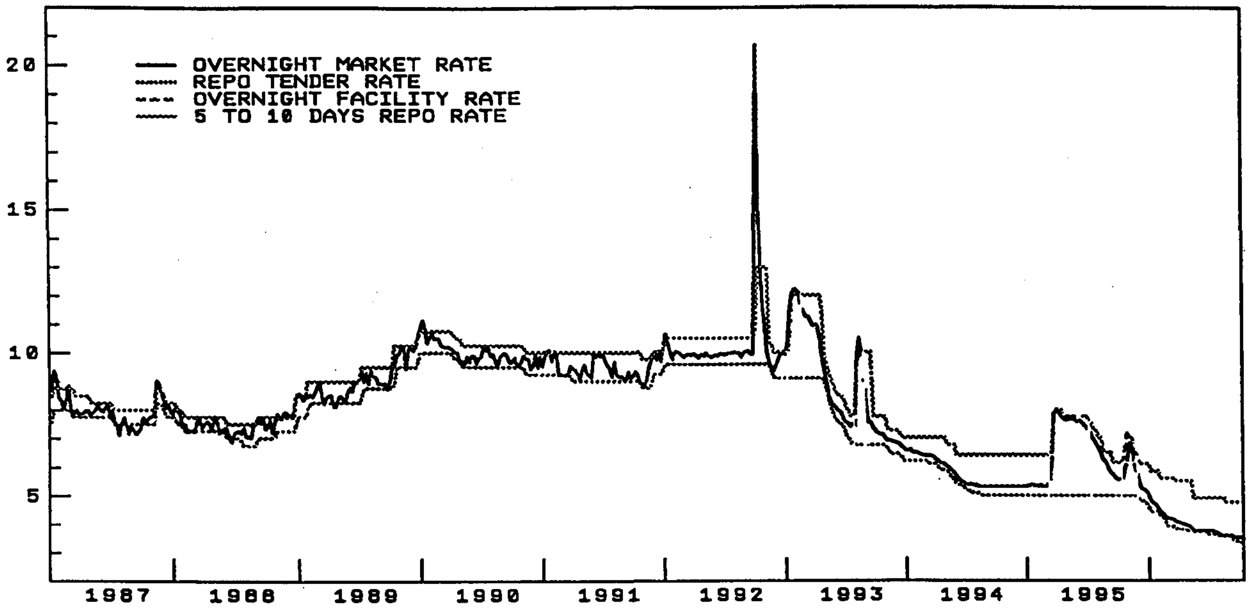
12 Normal times are defined by excluding periods of exchange rate pressure (from 1st September 1992 to 31st August 1993, 1st March 1995 to 30th June 1995 and 1st October 1995 to 15th November 1995).

- after 1992, and excluding periods of exchange rate tension, only the three-month rate seems to be caused by the overnight rate and the two intervention rates. The absence of a Granger causality between these rates and the one-month rate can be accounted for by the fact that the bulk of the adjustment takes place on the first day, as we will see below, and that this effect is not measured by standard Granger causality tests, due to the absence of contemporaneity.

2.3 Steering money market rates

Graph 3 plots the levels of the repurchase tender, five-to-ten-day window and overnight rates since 1987. It can be seen that, before 1992, the overnight rate usually lay within the interest rate corridor, although it was fairly flexible. After 1992, apart from periods of exchange rate pressure, the overnight rate was much more rigid. Although this goes beyond the scope of this paper, one can also note that as the Banque de France was successful in defending the franc, the interest rate rises required to alleviate exchange rate pressure became progressively less important.

Graph 3
Intervention and overnight rates since 1987



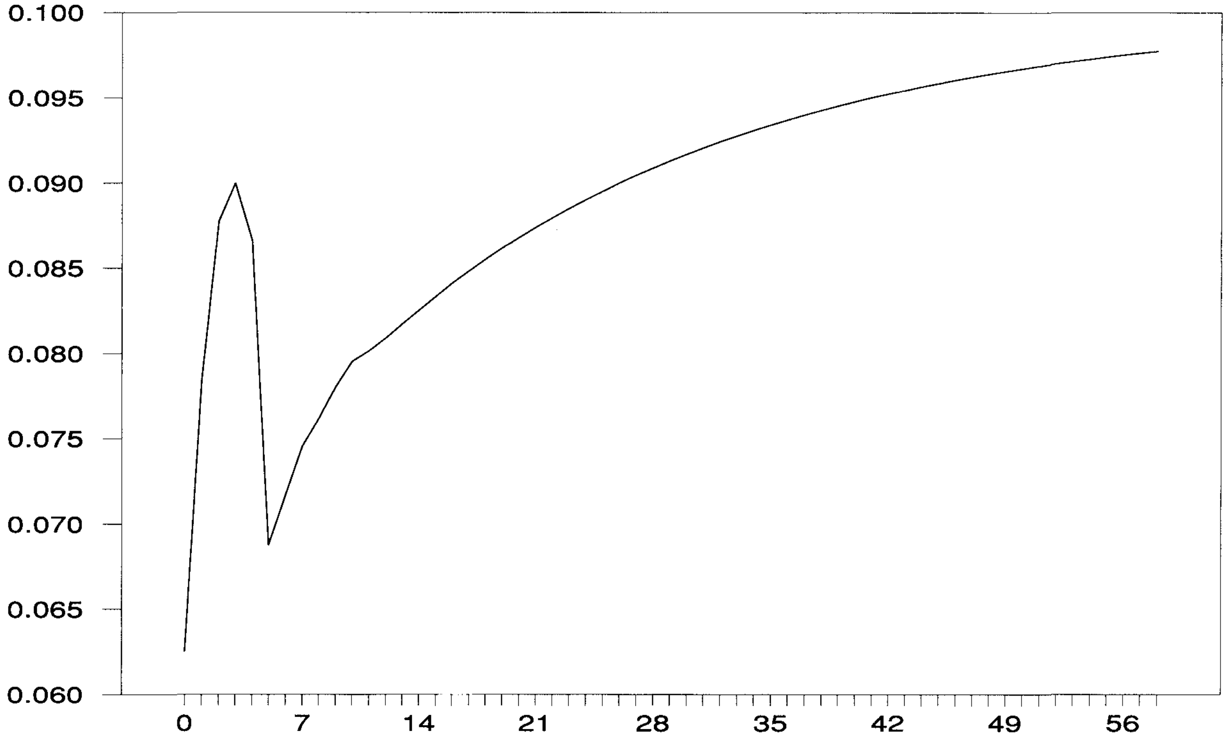
The transmission of monetary policy impulses to the money market is assessed by giving "shocks" to the rates that are relevant for the formation of the one- and three-month rates.[13] The shocks are standardised as a 10-basis-point increase.

Before 1992, it took the one-month rate one month to adjust up to 85% to a shock to the intervention rates and the overnight rate (Graph 4); after the same lapse of time, 80% of the same shock was reflected in the three-month rate (Graph 5).

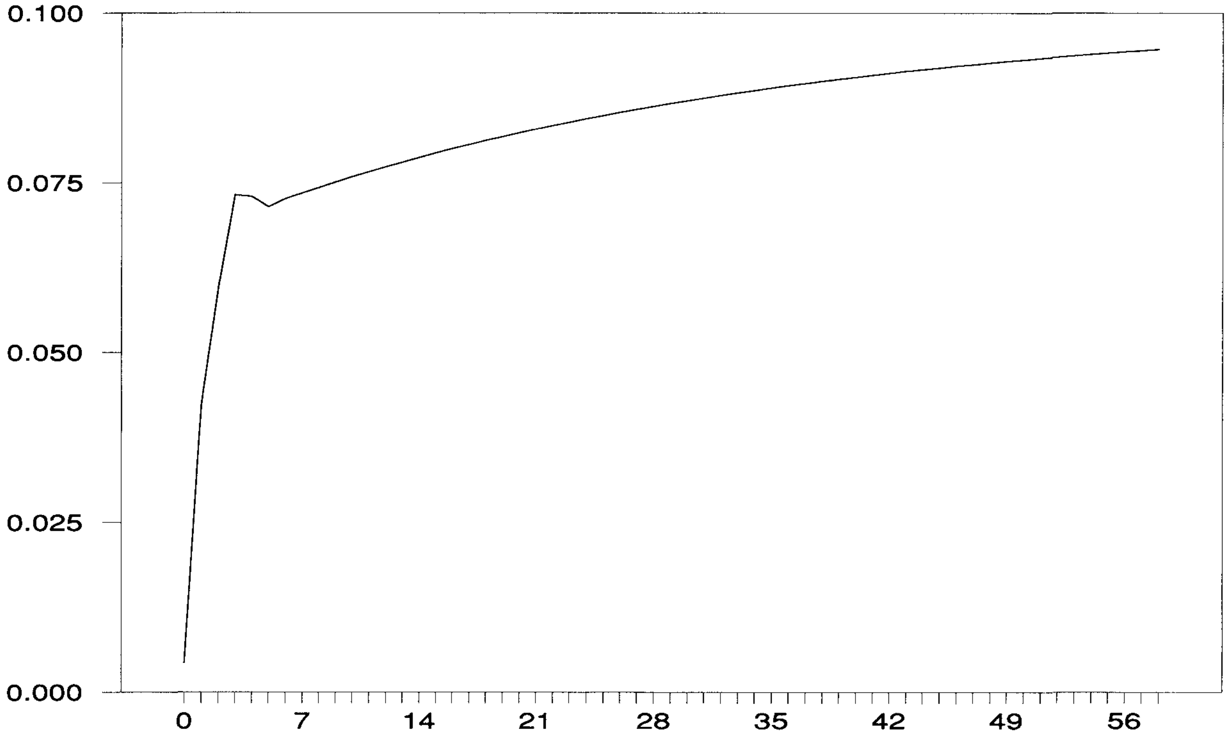
Since 1992, the money market has adjusted much faster: the pass-through of a change in the overnight onto the one-month rate (Graph 6) is completed after one week, with 92% of the adjustment taking place on the first day; the lag is approximately two weeks for the transmission of a change in both the overnight rate and the official rates to the three-month rate (Graph 7). In comparison with the period before 1992, the much more rapid transmission of monetary policy

[13] Although simpler, the approach used here is similar to the one employed in Ayuso, Haldane and Restoy (1994).

Graph 4
Response of the one-month rate to a monetary policy impulse before 1992

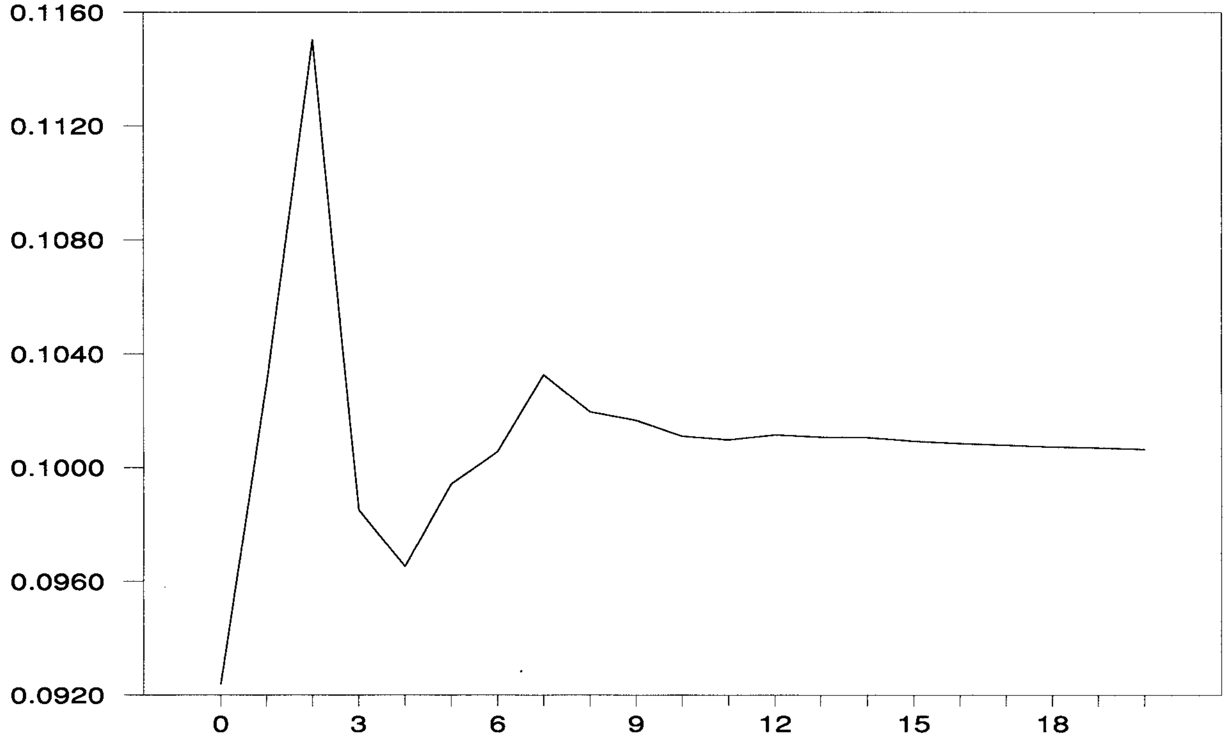


Graph 5
Response of the three-month rate to a monetary policy impulse before 1992



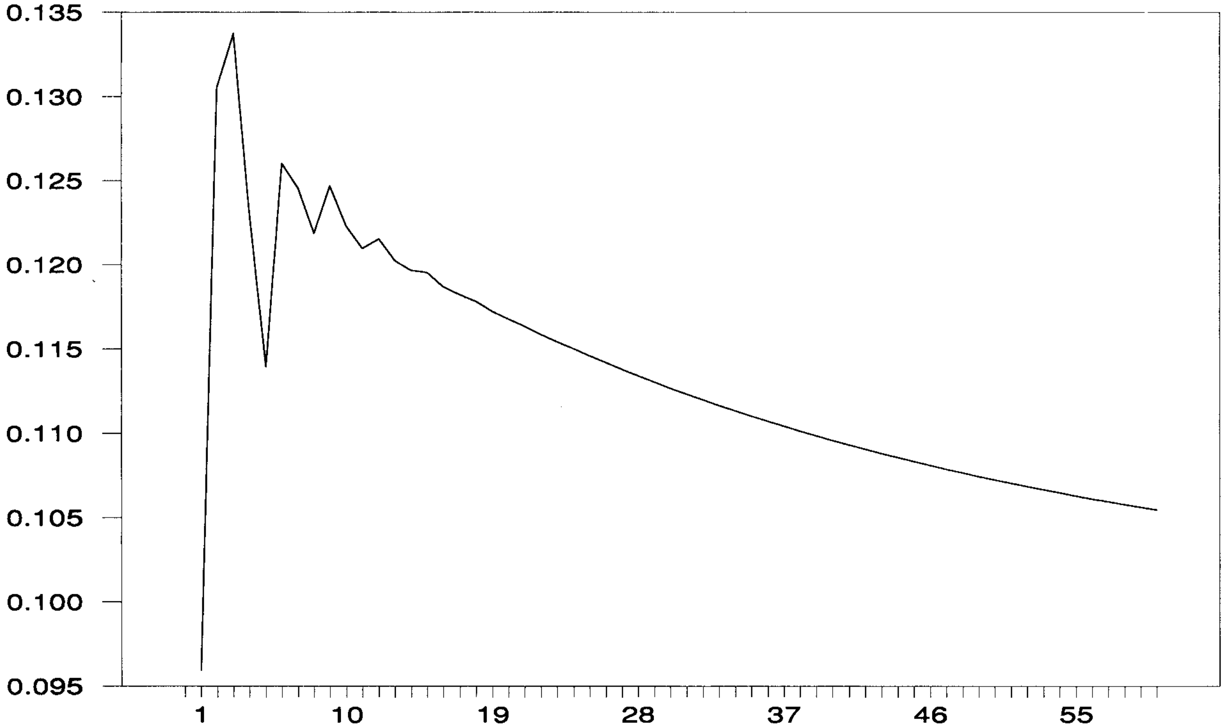
Graph 6

Response of the one-month rate to a monetary policy shock after 1992



Graph 7

Response of the three month rate to a monetary policy shock after 1992



impulses can be attributed to the market's understanding of the enhanced role played by the overnight rate in the conduct of monetary policy in the short term, and perhaps also to the increased efficiency of the money market resulting from the reforms implemented in the mid-eighties.

2.4 Overall assessment

It is clear that the operational framework of French monetary policy has gained in efficiency: apart from periods of exchange rate tension, the volatility of the one-month rate has decreased, in spite of a sharp reduction in reserve requirements, and the transmission of monetary policy impulses is now much more rapid. The enhanced role of the overnight rate can probably be accounted for by the fact that it is more closely monitored. Nevertheless, stability tests tend to show that it took the money market a fairly long time – approximately two years, from May 1992 to June 1994 – to adapt to a situation where the Banque de France kept the overnight rate under control and influenced it in order to convey signals on its monetary policy stance. Concerning the influence that the Bank's intervention rates continue to have over the three-month rate, the repurchase tender rate is still indicative of the medium-term policy orientation, which is consistent with the confidence shown by the Banque de France in not raising this rate in periods of tension on the foreign exchange market, while the five-to-ten-day repurchase window may track the "threat" the Banque de France lets hang over the markets; i.e. the extent to which it is ready to let market rates soar in the event of speculative attacks on the franc.

In these circumstances, the question that arises is to what extent has there been a shift in the Banque de France's monetary policy operating regime after 1992, and how should it be interpreted? Indeed, the emphasis has shifted from the use of an interest rate corridor to steer interbank rates and signal the monetary policy stance on the one hand, and reserve requirements to stabilise the demand for reserves on the other, towards more intensive recourse to open market fine-tuning operations. However, the elements of a "continental" model for the implementation of monetary policy have not been abandoned and the shift towards more intensive fine-tuning took place under the pressure of circumstances, as the increasing substitutability of European currencies made the foreign exchange constraint more binding. In this respect, it is worth noting that the European System of Central Banks (ESCB) is not expected to have an exchange rate target and that the euro will play an anchoring role in the monetary arrangements between countries participating in the euro area from the outset and EU countries with a derogation or an opt-out clause. On the whole, the current method of conducting monetary policy in France can be seen to be transitory.

3. Remarks concerning the future

In this Section, two questions are addressed:

- Is the imminent introduction of a Real-Time Gross Settlement (RTGS) system by the Banque de France likely to have consequences for the conduct of monetary policy?
- How might monetary policy instruments and procedures be adapted before the creation of the European Central Bank (ECB)?

3.1 Introduction of a Real-Time Gross Settlement (RTGS) System

An RTGS system, known as TBF ("Transferts Banque de France") will come on line at the Banque de France as of April 1997.[14] The introduction of this system is not expected to have any substantial consequences for the conduct of monetary policy.

First, it is quite unlikely that an intraday market for reserves will emerge. There are three reasons for this: there will be broad access to intraday liquidity; the central bank will provide this liquidity free of charge and only demand appropriate collateral; and the range of collateral that will be

[14] See Banque de France (1996).

accepted will itself be defined rather broadly, which means that the amount of intraday liquidity potentially available from the central bank will be extremely large.

Secondly, even if an intraday market were to emerge, it is very unlikely to "communicate" with the overnight rate since end-of-day overdrafts will be charged at a penalty rate higher than the five-to-ten-day repurchase rate and hence much higher than the overnight rate. More fundamentally, it seems that the separation between a possible intraday market and the money market would disappear only if the central bank were to radically change its operating procedures by intervening on a real-time basis for maturities shorter than one day (in this case, reserve requirements would also have to be computed on a real-time basis). Of course, the question arises as to why central banks should contemplate such a sweeping reform.

Even though no consequences are foreseen for the implementation of monetary policy, the Banque de France is anxious to avoid unduly disturbing market practices, e.g. by requiring participants in TBF to post much higher amounts of collateral than they would expect, which might in turn affect the liquidity of the interbank market. As a consequence, the timing of credits and debits to and from commercial banks' accounts with the central bank will be modified; for example, reserves allocated following repurchase tenders will be credited early in the morning.

3.2 Adaptation before the European Central Bank (ECB)

The ECB will probably be created in early 1998. Once it is created, it is clear that any amendments to existing instruments and procedures, as well as the creation of any new ones, will be inspired by the need to put in place the operational framework for the single monetary policy. This leaves only a year and a half to make "unilateral" changes. Consequently, any such changes will probably be limited in scope.

With regard to reserve requirements, their use for monetary control purposes, i.e. to influence developments in monetary aggregates, has not been abandoned. Nevertheless, there is an awareness of the risks of relocation of activities and disintermediation associated with non-remunerated reserves. In addition, M3 has been growing at an annual pace of 1.5%, on average, since its medium-term growth target was set at 5% at the start of 1994. However, the stabilising properties of reserve requirements could be enhanced, without increasing the reserve burden, by increasing the level of required reserves and remunerating them, especially if the interest paid is partially linked to very short-term market interest rates.[15] Even under such conditions, however, the Banque de France would have to be willing to accept a degree of volatility in very short-term interest rates; otherwise, fine-tuning open market operations might have to be conducted nearly as frequently as today, depriving the remuneration of compulsory reserves of most of its relevance.

Concerning open market operations, conducting variable-rate tenders occasionally, instead of the current fixed-rate repurchase tenders, would help extract information from market developments, but would have the same result as a more active role for reserve requirements; i.e. a degree of volatility in very short-term interest rates.

Finally, as regards standing facilities, creating a marginal lending facility and deposit facility, such as those the European Monetary Institute has suggested preparing for the ESCB,[16] could be contemplated. (In the case of the marginal lending facility, this could be done by shortening the duration of the five-to-ten-day repurchase window in order to use it as an end-of-day facility.) However, in this case also, the usefulness of such decisions may be questioned as long as the overnight rate is kept under control.

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15 See Vazquez (1995).

16 See European Monetary Institute (1996).

Appendix

We wanted to model the process by which monetary policy impulses are diffused to money market rates. Monetary policy impulses are identified with changes in Banque de France intervention rates—repurchase tender rate and five-to-ten-day repurchase rate—as well as changes in the overnight rate. The overnight rate results from the balance of supply and demand on the interbank market and is normally affected by changes in the "autonomous factors" of liquidity. However, the central bank may intervene to clear the market and smooth "ex ante" rate fluctuations. Furthermore, the overnight rate plays an important role on the French money market with over 70% of interbank loans being traded on this maturity.[17] Therefore, in the following, the overnight rate will be included in the range of rates through which the central bank may influence longer money market maturities.

This appendix is divided into five sections: after describing the data used, we construct a volatility indicator for the overnight, one- and three-month rates (Section 1). From this initial examination of the data, we infer the existence of three distinct periods, each one corresponding *a priori* to a specific regime for the diffusion of monetary impulses to money market rates. We then test the causality of various explanatory variables over the three periods (Section 2). In a third section, we describe the features of the selected model and assess its robustness. The fourth section is devoted to testing the stability of the model over the three periods. In the last section, we simulate the diffusion of policy shocks and discuss the results.

1. An initial examination of the data

We used daily data, provided by the Capital Markets Division of the Banque de France, on the repurchase tender rate (*AO*), the ceiling rate (*pension*),[18] the overnight rate (*jj*), the one-month PIBOR (*f1m*), the three-month PIBOR (*f3m*) and the Deutsche mark one-month FIBOR (*a1m*). The data span the period 01/01/87 – 10/09/96. The *jj* is the average bid-offer rate quoted at 11.30 a.m. We used five data series per week. Weekends are excluded. For non-working days, we reproduced the data of the previous working day.

A first empirical approach consisted in estimating the volatility of the money market rates, including the overnight rate. In order to eliminate trend effects that may cause the volatility of a variable to be overestimated, we referred to detrended variables. To this end, one can either estimate the variance of the variables minus their moving average or deduce the repurchase tender rate – which is supposed to represent the trend – from each of the variables. By analogy with the work conducted at the EMI,[19] we used the second method. The volatility of variable X on time t was estimated by computing the variance of X on the interval $[t-15, t+15]$.

Graphs 1 to 3 in the main text suggest that there were three distinct periods, each corresponding *a priori* to a specific regime as regards the reaction of money market rates to changes in the intervention or overnight rates:

- before 1992, the overnight rate appeared much more volatile than the intervention rates;
- after 1992, and excluding periods of exchange rate pressure, the controlled volatility of the overnight rate was accompanied by limited volatility on longer maturities; and

[17] See Paul and Wilhelm (1996).

[18] The *pension variable* is compiled from the five-to-ten-day window rate under "normal" circumstances and the overnight facility rate in "exceptional" circumstances corresponding to periods of foreign exchange tension. Moreover, the data include a variable that is indicative of the exceptional nature of the overnight facility.

[19] See Escrivá and Fagan (1996).

- foreign exchange crises make up the third period, during which the management of the money market was based on the overnight (and overnight facility) rate, while the repurchase tender rate remained stable.

Empirically, the transition from a regime of moderate overnight rate volatility to a regime of more limited volatility took place in the course of March 1992. From a policy point of view, the closest significant measure was the reduction in reserve requirements on 16th May 1992. Accordingly, we chose that date as a "turning point".

We therefore defined the following three periods:

- period 1 spans 01/01/87 to 15/05/92;
- period 2 spans 16/05/92 to 10/09/96, excluding moments of foreign exchange pressure; and
- period 3 corresponds to moments of foreign exchange tension (from 01/09/92 to 31/08/93, 01/03/95 to 30/06/95 and 01/10/95 to 15/11/95).

2. Selection of the appropriate explanatory variables

In order to select the appropriate explanatory variables, we ran Granger causality tests.

The series have been differentiated so as to work in a stationary environment.

The results, as summarised in Table 1, highlight four types of phenomena, of which the last two were not expected *a priori*:

- in period 1, there is a causal relation between the intervention and overnight rates, and the money market rates (one-month and three-month PIBOR);
- excluding periods of exchange rate tension, the Deutsche mark one-month FIBOR displays very limited explanatory power. In this respect, the liberalisation of capital flows does not seem to have resulted in greater interdependence between money market rates. However, the first significant measures in this area were implemented as early as 1986, before the period under review;
- in period 2, only the three-month rate seems to be caused by the two intervention rates and the overnight rate. However, the absence of a Granger relationship of cause and effect between those rates and the one-month rate does not necessarily prove that the former are inefficient in steering the latter. Indeed, this absence of causality can be accounted for by the fact that the bulk of the adjustment takes place on the first day, as we will see below, and that this effect, which expresses increased monetary policy efficiency, is not measured by standard Granger causality tests, due to the lack of contemporaneity; and
- throughout the period under review, there is a causal relationship between the one-month rate and the overnight rate. This may reflect the accuracy of market expectations.

Table 1
Granger causality tests

Period 1: from 01/01/87 to 15/05/92

Period 2: from 15/05/92 to 10/09/96, excluding periods of exchange rate tension

Period 3: foreign exchange turbulence

One-month PIBOR – Fischer statistics

Explanatory variable	Period 1		Period 2		Period 3	
jj	4.5	(0.05)	1.5	(19.8)	10.0	(24.4)
AO	1.5	(17.8)	0.8	(57.5)	0.1	(99.5)
pension	8.0	(0.0)	2.1	(6.2)	3.5	(0.4)
alm	1.0	(42.6)	1.3	(25.2)	4.7	(0.04)

Overnight rate – Fischer statistics

Explanatory variable	Period 1		Period 2		Period 3	
One-month PIBOR	5.0	(0.01)	6.3	(0.0)	2.7	(2.1)
AO	2.5	(2.7)	1.2	(32.7)	0.01	(100.0)
pension	7.7	(0.0)	6.3	(0.0)	3.7	(0.3)
Three-month PIBOR	0.41	(84.0)	2.3	(6.1)	1.3	(27.7)

Three-month PIBOR – Fischer statistics

Explanatory variable	Period 1		Period 2		Period 3	
jj	25.3	(0.0)	6.0	(0.0)	6.7	(0.0)
AO	4.3	(0.08)	1.4	(23.4)	0.2	(97.3)
pension	18.8	(0.0)	3.8	(0.2)	5.0	(0.02)
One-month PIBOR	139.1	(0.0)	108.7	(0.0)	51.7	(0.0)

Note: Figures in brackets are the p-values (as a percentage).

3. Selection of a model and assessment of its robustness

We tried to establish a cointegration relationship between the overnight rate and the money market rates.

Applying the Dickey-Fuller test (see Table 2) led us to reject the null hypothesis of non-stationarity of the spread between the money market rates and the overnight rate.

Table 2
Results of the Dickey-Fuller test

	Period 1		Period 2	
One-month PIBOR	- 0.19	(- 12.3)	- 0.09	(- 5.7)
Three-month PIBOR	- 0.13	(- 9.9)	- 0.04	(- 3.8)

The table gives the values and t-statistics of the coefficient of $z(t\text{-}1)$ in the regression of $\Delta z(t)$ over $z(t\text{-}1)$, where z is the centred spread of the money market rates vis-à-vis the overnight rate $(z = fim - jj - \mathrm{E}(fim - jj))$.

Results of the stability test (Chow test)

Over the two periods 01/01/87 to 01/07/90 and 01/07/90 to 15/05/92

	Fα	P-values
One-month PIBOR	0.85	68.4%
Three-month PIBOR	1.22	20.9%

Over the two periods 15/05/92 to 01/03/95 and 02/03/95 to 10/09/96

	Fα	P-values
One-month PIBOR	1.725	5.3%
Three-month PIBOR	3.89	0.0%

Consequently, the spreads between the money market rates and the overnight rate converged in the long run and we sought to model the short-term fluctuations of the $f1m$ and $f3m$ rates around their long-term target, using an error-correction model with the following form:

$$\Delta fim(t) = Cste + \sum_{i=1}^{5} \alpha_i \Delta\, fim(t-i) + \sum_{j=0}^{5} \beta_j \Delta\, jj(t-j) + \sum_{k=0}^{5} \gamma_k \Delta\, X(t-k) + \sum_{l=0}^{5} \delta_l \Delta\, Y(t-l) + \theta\,(fim(t-1) - jj(t-1))$$

$i = 1, 3$ [1]

where the $(fim(t\text{-}1)\text{-}jj(t\text{-}1))$ term corrects any temporary deviation of the variables from their long-term target and the $\Delta X(t)$ and $\Delta Y(t)$ terms express the information on changes in the leading rates in time t that would not already be included in the $\Delta jj(t)$ term (obviously, one thinks of the repurchase tender rate and the ceiling rate).

In order to avoid problems of colinearity between explanatory variables, we tested for $X(t)$ and $Y(t)$ variables that are orthogonal to the overnight rate and contain as much information as possible on the repurchase rate and the ceiling rate. A solution was to use the residuals of the regressions of *AO* and *pension* over the overnight rate. The (*pension-jj*) and (*AO-jj*) variables can be considered as good proxies of the residuals.

Table 3
One-month PIBOR

$$\Delta fim(t) = Cste + \sum_{i=1}^{5} \alpha_i \,\Delta fim(t-i) + \sum_{j=0}^{5} \beta_j \,\Delta jj(t-j) + \sum_{k=0}^{5} \delta_k \Delta(pension - jj)(t-k)$$
$$+ \sum_{l=0}^{5} \gamma_l \Delta(ao - jj)(t-l) + \theta(f1m - jj)(t-1)$$

	Period 1		**Period 2**	
R^2	0.37		0.22	
SEE	0.06		0.07	
DW	2.00		2.01	
Cste	0.01	(3.85)	0.01	(3.13))
α1	-0.10	(-3.79)	- 0.04	(- 1.11)
α2	-0.10	(-3.63)	0.11	(2.97)
α3	-0.03	(-1.21)	- 0.12	(- 3.30)
α4	-0.05	(-1.70)	- 0.09	(- 2.48)
α5	-0.04	(-1.51)	0.05	(1.40)
β0	0.63	(12.04)	0.92	(12.20)
β1	0.20	(3.66)	0.14	(1.69)
β2	0.16	(2.89)	0.02	(0.25)
β3	0.06	(1.10)	- 0.05	(- 0.57)
β4	0.01	(0.10)	0.06	(0.69)
β5	-0.15	(-3.09)	0.02	(0.23)
γ0	0.17	(3.96)		
γ1	0.12	(2.58)		
γ2	0.12	(2.61)		
γ3	0.08	(1.92)		
γ4	0.08	(2.09)		
γ5	-0.09	(-2.73)		
δ0	0.18	(5.39)		
δ1	0.06	(1.45)		
δ2	0.01	(0.23)		
δ3	-0.05	(-1.17)		
δ4	-0.07	(-1.55)		
δ5	-0.10	(-2.38)		
θ	-0.06	(-6.09)	- 0.08	(- 4.15)

Over period 1, we reject the null hypothesis of non-significance of the coefficients of *(pension-jj)* and of *(AO-jj)*: $F(12.371) = 7.84 \quad p = 0.00$.

Over period 2, we accept the null hypothesis of non-significance of the coefficients of *(pension - jj)* and of *(AO- jj)* at the 87% confidence level. The result of the F-test is: $F(12.721) = 0.57$.

Table 4
Three-month PIBOR

$$\Delta f3m(t) = Cste + \sum_{i=1}^{5} \alpha_i \, \Delta f3m(t-i) + \sum_{j=0}^{5} \beta_j \, \Delta jj(t-j) + \sum_{k=0}^{5} \delta_k \Delta\big(pension - jj\big)(t-k)$$
$$+ \sum_{l=0}^{5} \gamma_l \Delta(ao - jj)(t-l) + \theta(f3m - jj)(t-1)$$

	Period 1		Period 2	
R^2	0.16		0.19	
SEE	0.07		0.07	
DW	2.00		2.00	
Cste	0.01	(3.70)	0.01	(2.66)
α1	-0.05	(-1.97)	-0.01	(-0.20)
α2	-0.10	(-3.83)	-0.16	(-4.13)
α3	0.02	(0.93)	0.17	(4.07)
α4	-0.02	(-0.79)	-0.14	(-3.62)
α5	0.00	(0.11)	0.01	(0.15)
β0	0.04	(0.71)	0.96	(7.58)
β1	0.35	(5.70)	0.35	(2.66)
β2	0.17	(2.81)	0.20	(1.46)
β3	0.17	(2.75)	-0.20	(-1.47)
β4	0.00	(0.07)	0.00	(0.01)
β5	-0.01	(-0.13)	0.15	(1.11)
γ0	0.00	(-0.02)	0.45	(4.57)
γ1	-0.01	(-0.18)	-0.06	(-0.61)
γ2	0.07	(1.25)	-0.06	(-0.57)
γ3	0.12	(2.34)	-0.15	(-1.50)
γ4	-0.01	(-0.29	-0.08	(-0.84)
γ5	-0.01	(-0.25)	0.14	(1.40)
δ0	0.00	(-0.03)	0.07	(2.65)
δ1	0.31	(6.74)	0.09	(3.08)
δ2	0.02	(0.31)	-0.04	(-1.23)
δ3	0.04	(0.77)	-0.03	(-0.89)
δ4	0.00	(0.01)	0.00	(0.02)
δ5	0.00	(0.06)	0.02	(0.82)
θ	-0.04	(-5.03)	-0.03	(-2.78)

Period 1: F (12.1370) = 6   p = 0.00.

Period 2: F (12.715) = 4.08   p = 0.00.

The results are summarised in Tables 3 and 4. Two distinct regimes clearly appear, in the sense that the values of the model coefficients greatly depend on the period considered.

The fact that the error-correction term (θ coefficient) is significant confirms that there is a cointegration relationship between the money market rates and the overnight rate.[20]

After 1992, adding the repurchase tender rate and the ceiling rate does not improve the forecast of the one-month PIBOR (i.e. the HO hypothesis according to which the γ_k and δ_1 coefficients are all supposed to be equal to zero – see Table 3 – is accepted). It looks as if the overnight rate was implicitly granted the status of a leading rate by the market and supplanted the repurchase tender and ceiling rates. However, the latter retain a predictive power for the three-month rate.

Before 1992, the coefficients of the repurchase tender and ceiling rates were significant and these rates provided the market with information that is not entirely contained in changes in the overnight rate.

The robustness of the model relies on the hypothesis of homoscedasticity of the residuals. Ayuso et al. (1994) seek to estimate a seasonality effect in the volatility of the interbank rates: since reserve requirements are computed over a given period, banks can react to liquidity shocks by adjusting the level of their reserves with the central bank. Consequently, the volatility of interbank rates is supposed to increase as the end of the computation period approaches. As far as Germany is concerned, the seasonality pattern in the variance of the process is brought to light. In the case of France, the seasonality pattern is hardly perceptible. Therefore, the hypothesis of homoscedasticity in our model does not appear especially strong.

4. Stability of the model

The stability of the model over each of the periods considered can be assessed through tests of regime shifts (Chow tests). Over period 1, the results of the tests confirm the stability of the model (see Table 2). After 1992, the hypothesis of stable determinants for the one-month PIBOR is hardly accepted at the 5% significance level. However, the results of the tests are clearly consistent with such a hypothesis after mid-1994.[21] Besides, the hypothesis of stable determinants for the three-month PIBOR after 15th May 1992 is rejected. The regime appears stable only after the last period of foreign exchange tension in October 1995.

It thus looks as though the markets had gradually adapted to a situation where the volatility of the overnight rate was controlled.

5. Diffusion of policy shocks

In period 3, control over the overnight rate was exercised in order to pursue an exchange rate objective and its role as a means of regulating the money market rates appears secondary. Consequently, we will limit our investigations to the diffusion of monetary policy shocks in periods 1 and 2.

By construction, changes in the intervention and overnight rates are entirely passed through to money market rates in the long run, whatever the simulation period: the "one for one" reaction is guaranteed in our model by the error-correction term (see Section 3). Differences between the simulation periods will thus not relate to the size of the adjustment of the money market rates, but to the speed of this adjustment.

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[20] There are at most four cointegration relationships between the 1-month PIBOR, 3-month PIBOR, *AO*, *pension* and *jj* series. We have made an *a priori* selection for the long-term relationships between these variables.

[21] After 1992, Chow tests were conducted with a break on 01/03/95.

Shocks are standardised as a 10-basis-point increase in the "leading" rates. The reaction of money market rates in comparison with the baseline scenario – i.e. that of unchanged "leading" rates – is then observed. The results are plotted in Graphs 4 to 7 in the main text.

Before 1992 (Graphs 4 and 5), the adjustment of money market rates was relatively slow: it took the one-month PIBOR one month to adjust up to 85% to a shock; after the same period of time, 80% of the shock was reflected in the three-month PIBOR. After 1992 (Graphs 6 and 7), the adjustment was very rapid, with more than 92% of it as early as the first day for the one-month PIBOR. After five days, the adjustment was nearly completed. In the case of the three-month PIBOR, there is a slight over-reaction that is unlikely to be statistically significant.

Comparison of Graphs 4 to 7 suggests several conclusions:

- before 1992, the markets were accustomed to a degree of volatility in the overnight rate. As a consequence, any change in the level of this rate was interpreted less as a change in the monetary policy stance than as a sign of historical volatility. Markets adjusted in the long term if they observed that a shock on the "leading" rates was perpetuated, but they only progressively ratified shocks that corresponded to a change in the monetary policy stance. This may be due to the fact that the historical volatility of the overnight rate might have blurred any message that the central bank wanted to send to the market. It may also be due to the absence of regular open market operations conducted within the interest rate corridor, as carried out in Germany, for instance;
- from the beginning of 1992 to the beginning of 1994, the markets became progressively accustomed to limited volatility in the overnight rate. From 1994 onwards, the markets clearly interpret a change in the overnight rate as signalling a tightening or a loosening of monetary policy. One can then speak of greater efficiency in the operational framework insofar as the transmission of monetary policy impulses is much more rapid. However, the repurchase tender rate and five-to-ten-day window rate retain some explanatory power over the three-month rate. In this respect, they anchor medium-term market anticipations. For example, in a situation where a rise in the overnight rate is needed to support the currency, keeping the repurchase tender rate stable can be interpreted by the markets as an indication that the medium-term policy orientation is unchanged. Consequently, this signals the confidence of the central bank in the transitory and limited nature of the foreign exchange turbulence and suggests to the markets that the overnight rate should return to its previous levels in the medium-term. From 1992 to 1994, the markets may have made sure that, as in the past, the repurchase tender rate and the five-to-ten-day window rate were indicative of the medium-term orientation of monetary policy, while changes in the overnight rate could be seen as moves of a more tactical nature.

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Monetary policy operating procedures in Switzerland

Erich Spörndli and Dewet Moser

1. Outline of the process of implementing monetary policy

The primary objective of Swiss monetary policy is price stability. Our intermediate target is the monetary base, which is composed of bank notes in circulation and giro deposits (demand deposits held with the SNB by commercial banks). The primary operating target is the level of giro deposits. Under normal circumstances, the Governing Board issues each quarter an operating guideline based on a wide range of information. This information includes first of all the difference between the actual level of the monetary base and its medium-term target path. In addition, the SNB always retains the option of reacting to unexpected developments such as strong fluctuations in the exchange rate and in the demand for money. Should unanticipated problems arise, the Governing Board may revise its guideline for the level of giro deposits within the same quarter. Following the guideline, the Monetary Operations Division implements monetary policy. Monetary operations are reviewed weekly by our money market committee.

Giro deposits are supplied primarily through revolving foreign exchange swaps. Additional refinancing is provided by modest but steady purchases of domestic securities in the open market. Foreign exchange swaps are carried out exclusively against US dollars. Swaps are usually concluded to add giro deposits, by purchasing dollars in the spot market and simultaneously selling them in the forward market. Only rarely does the SNB offer reverse swaps – spot sales together with forward purchases of dollars – to reduce giro deposits. Since almost every day a fraction of outstanding swaps are maturing, the banking system is systematically short of giro deposits. Therefore, in normal circumstances, the SNB must only add liquidity. Swap transactions are conducted at market terms. Swap maturities range from one week to twelve months.

Monetary operations are carried out every day. We distinguish between basic and fine-tuning operations. Foreign exchange swaps constitute our basic provider of liquidity. They are completed according to the following procedure: interested banks call the SNB at 9 a.m. – we inform them whether we are willing to conduct swap transactions and, if so, on what terms (maturity and price). The banks then state the quantity of giro deposits they are ready to acquire at these conditions. Finally, we accommodate the demand up to the quantity of giro deposits we intend to supply. Fine-tuning operations are conducted from 9.00 a.m. to 3.00 p.m. They occur mainly when unexpected changes in note circulation or in the government's sight deposits account at the SNB cause giro deposits to deviate markedly from their target level.

Sporadically, fine-tuning operations may be used to counteract sharp moves in money market rates. In order to add (reduce) giro deposits at short notice, the SNB transacts short-term (reverse) repurchase agreements with Treasury bills issued by the Confederation (the bills take the form of book-entry claims). Alternatively, the SNB may add giro deposits by depositing Treasury funds in the market.

To overcome unforeseen last-minute losses of giro deposits, banks can borrow giro deposits temporarily (owed for a minimum of one business day) in the form of lombard loans, i.e. advances against collateralised securities. The flexible lombard rate, which is fixed daily at a spread of two percentage points above the call money rate, ensures that banks borrow giro deposits only exceptionally.

The discount rate is fixed by discretion and is normally held below money market rates. As a policy instrument, the discount rate is no longer important as the SNB has ceased to discount bills.

2. Banks' demand for giro deposits, liquidity requirements and the Swiss money market

The imposition of minimum reserve requirements, while permitted by the National Bank Law, has been discontinued since 1977. However, cash liquidity requirements imposed for prudential purposes and anchored in Swiss banking legislation affect the demand of banks for central bank money.

2.1 The determinants of giro demand

Banks' demand for giro deposits is determined by the aforementioned cash liquidity requirement and by the need for working balances in the interbank payment system, notably the Swiss Interbank Clearing System (SIC). The liquidity requirement does – in practice – set a lower bound to banks' giro deposit demand. On average across all banks, actual cash liquidity exceeds the requirement by more than 20%. For the banks active in the money market, however, excess liquidity ranges below 10%.

2.2 The liquidity requirement

The basic features of the liquidity requirement are: (i) the minimum liquidity is computed as a fixed percentage (2.5%) of a specified range of banks' liabilities; (ii) applicable liquidity comprises central bank money – i.e. banks' vault cash plus giro deposits – and checking balances with the postal giro system; (iii) the minimum liquidity has to be maintained on average over a period of 30 days; and (iv) the requirement is calculated on a lagged basis and hence is known at the beginning of the maintenance period.

2.3 The Swiss money market

The bulk of domestic money market transactions comprises interbank deposits, i.e. uncollateralised short-term loans. The market is subject to standard business terms and procedures. A market for intraday credits has not evolved yet, although the settlement of intraday funds would be conceivable within the SIC.

Until the early 1990's, there existed virtually no marketable domestic money market instrument. This was due to both the absence of public borrowers from the market and an unfavourable tax treatment of such instruments. Only over the past years of rising budget deficits has the Confederation started to intensify issuing short-term debt. In light of the evolving market for Treasury bills, the SNB began to trade such bills for fine-tuning operations. The interbank repo market, however, is still negligible. The borrowing and lending of securities, on the other hand, is gaining ground.

3. Disturbing shifts in banks' demand for giro deposits

The introduction of the present system of cash liquidity requirements on 1st January 1988, caused – together with the more or less simultaneous introduction of SIC (a real time gross settlement system RTGS) – major shifts in banks' demand for giro deposits. The average monthly volume of giro deposits fell, between 1988 and 1990, in several steps from SF 8 to 3 billion. Since then, the present system of operating procedures as described above has been working without major problems *most of the time.*

On several occasions, though, disturbances arose from further shifts in banks' giro demand as they more and more strove to minimise their holdings of excess cash liquidity. In 1991, increased holdings of liquidity in postal checking balances, together with improved cash management at several banks, caused a downward shift of banks' demand for giro deposits by some SF 200 to 300 million. A similar downward shift occurred once again in 1994.

In the course of 1996, major disturbances led to tensions in the money market. The easing of monetary policy in 1995 had caused structural adjustments of banks' balance sheets. Substantially more short-term liabilities, like demand and savings deposits were held by the public. This increased the level of banks' required cash liquidity quite substantially. At first, banks did cover this higher requirement by holding more vault cash and higher amounts in postal checking balances.

Several of the major banks, however, began to reduce the balances held with the postal checking system in spring 1996. To compensate for this, they held more giro deposits with the SNB. We did, in May and June, raise the supply of giro deposits. But this proved not to be sufficient to cover the whole increase in banks' demand. As a consequence, the aforementioned turbulences and tensions in the money market emerged, and short-term rates of interest rose from below 2% in March to roughly 2.5% in June (three-month Euro-market rate).

The markets seemed to interpret the events in spring and early summer 1996 as a deliberate move of the SNB towards a tighter stance of monetary policy. The already strong Swiss franc exchange rate began to appreciate further. In July and August, the increase in banks' demand for giro deposits continued at an accelerating pace. We reacted by increasing the supply of giro deposits drastically – in order to calm the markets and to convince them that the SNB did not want the recurring turbulences to cause a permanent increase in short-term interest rates. *To achieve this, we had to temporarily abandon the quantitative approach of our operating procedures.* We injected so much liquidity into the market that by mid-September the overnight rate had fallen back to a range between 1¼ and 2%. The three-month Euro-market rate also fell and fluctuated by mid-September in a narrow band below 2%.

4. Information to markets: what do we tell them - what not?

We make no public announcements about the *operating target* (the amount of giro deposits) aimed at. Every ten days, we publish a condensed balance sheet statement that shows the level of giro deposits of that particular day. Ex post, the monthly average of giro deposits, the total volume of outstanding foreign exchange swaps, and the Treasury bill positions are published in our monthly bulletin.

4.1 Signals about desired interest or exchange rate adjustments

In times of financial market turbulences, like in the spring and summer of 1996, the SNB may give the market indications, if it deems the level of short-term interest rates or the exchange rate inappropriate. This information is usually spread by:

- Signals to the market in the form of foreign exchange swaps with long maturity and at relatively favourable conditions (when we think money market interest rates should be lower). In these cases, news agencies and journalists usually react quickly to find out whether the special operations were meant to be signals.
- Members of the governing board of the SNB may indicate in their speeches that we deem some money market interest movements or some exchange rate excesses as inappropriate. Such remarks, however, always tend to be in very general terms. We never give the markets precise hints as to what interest or exchange rate levels should be aimed at.

4.1 Information on money market operations

New foreign exchange swaps are transacted to offset due swaps, to compensate technical or seasonal drains in giro deposits, or to provide the market with additional liquidity. As a rule, market participants do not know whether the SNB, on a given day, will offer new swaps. If an operation takes place, banks do not know the total amount of swaps or how much individual participants will be allotted.

Fine-tuning operations like depositing Treasury funds in the market or repurchase operations on Treasury bills may take place during the trading day till 3 p.m. Market participants do not know whether the SNB will do such fine-tuning operations or what the amounts might be.

5. Volatility of the operating target and of short-term interest rates

Pursuing a quantitative operating target implies a willingness to tolerate a certain amount of day-to-day volatility in very short-term interest rates like the overnight or the tomorrow-next rates. In addition, we are willing to tolerate quite large day-to-day fluctuations in the level of the operating target. Trying to achieve the guideline value of giro deposits on each day would need an excessive amount of fine-tuning operations. This we try to avoid. Allowing day-to-day fluctuations in the operating target and in very short-term interest rates fits in with our information policy as described in Section 3.

We feel there is a need to leave the markets with some uncertainty about our short-term tactics. Given our small open economy with a large financial centre, we believe that providing the markets with complete information on our short-term plans, or pursuing and announcing a target value for the overnight rate, could produce undesirable effects. With an interest rate target fixed for several weeks, we might, for instance, see increased short-term volatility of the Swiss franc exchange rate. Speculative attacks to test our resolve of defending a particular interest rate level could also occur in case we let the markets know too much about our short-term intentions and actions. *We do not want to open opportunities for riskless (or near-riskless) speculative activities by market participants.* We think this is best done by leaving some uncertainty in the markets.

Does the described attitude towards day-to-day volatility of very short-term interest rates cause excess volatility in the markets in general? This question we are often asked by central bankers that use a short-term interest rate as the operational target and are engaged explicitly in interest rate smoothing.

Figures 1 to 3 show that day-to-day volatility in the very short-term rates does not cause excessive volatility in the three month rate – at least not since the adoption of the new cash liquidity requirements and the corresponding operating procedures in 1988. Before, volatility of the tomorrow-next rate was quite high (see Figure 2), but many of these fluctuations were ironed out by the market itself. This can be seen from Figure 1: the three-month rate prior to 1988 followed a much smoother path than the tomorrow-next rate. Figure 3 shows this smoothing function of the market for the period since 1988. Annual averages of the volatility of the Swiss tomorrow-next rate are more than double the volatility of the Swiss three month rate. In addition, Figure 3 shows that short-term volatilities of US and German three-month rates were of the same order of magnitude as the volatility of the Swiss three-month rate – despite our different approach to implementing policy.

Figure 1

Swiss short-term interest rates

Monthly averages of daily observations

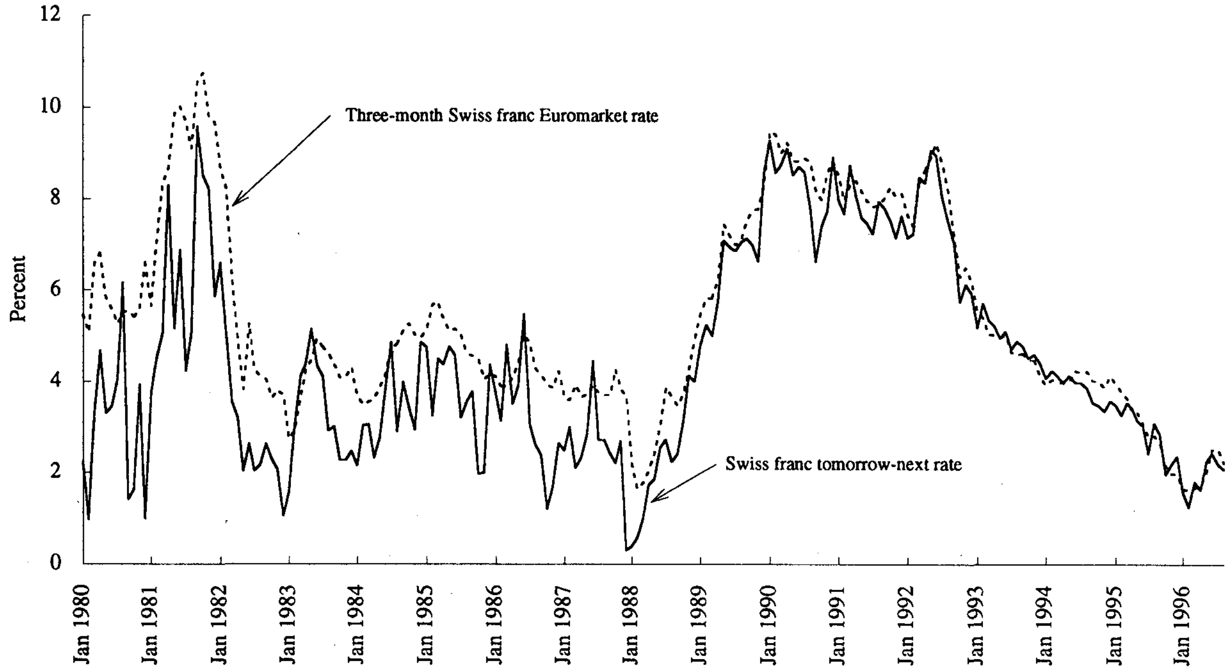


Figure 2

Volatility of the Swiss franc tomorrow-next interest rate

Standard deviation of daily observations from a thirty-day moving average

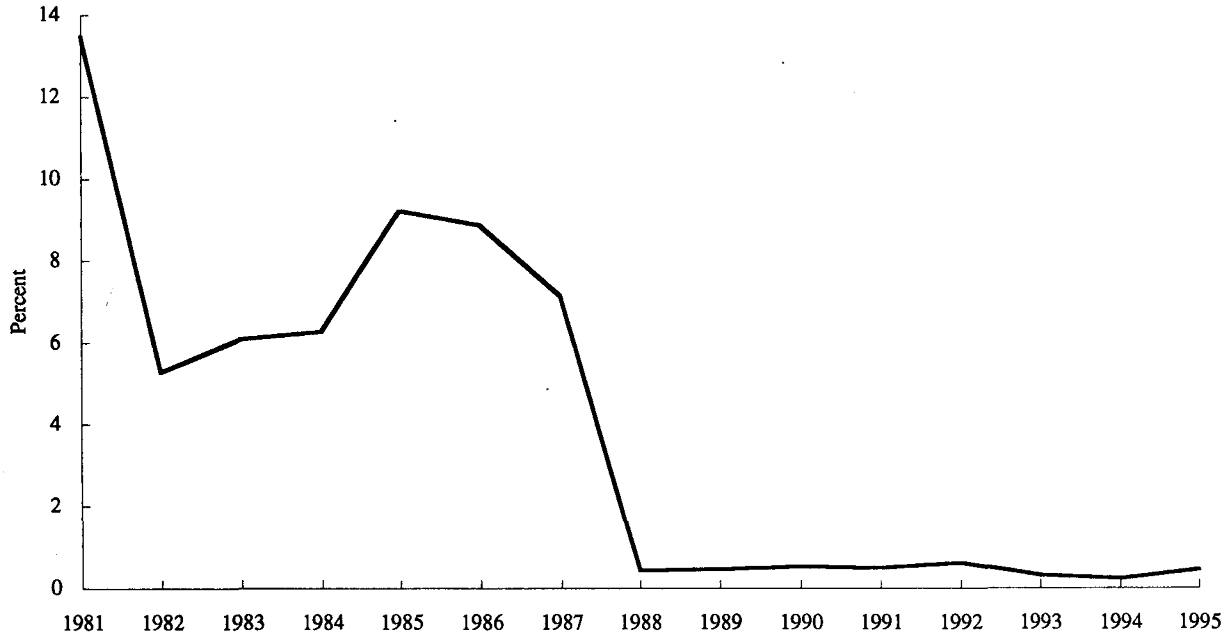
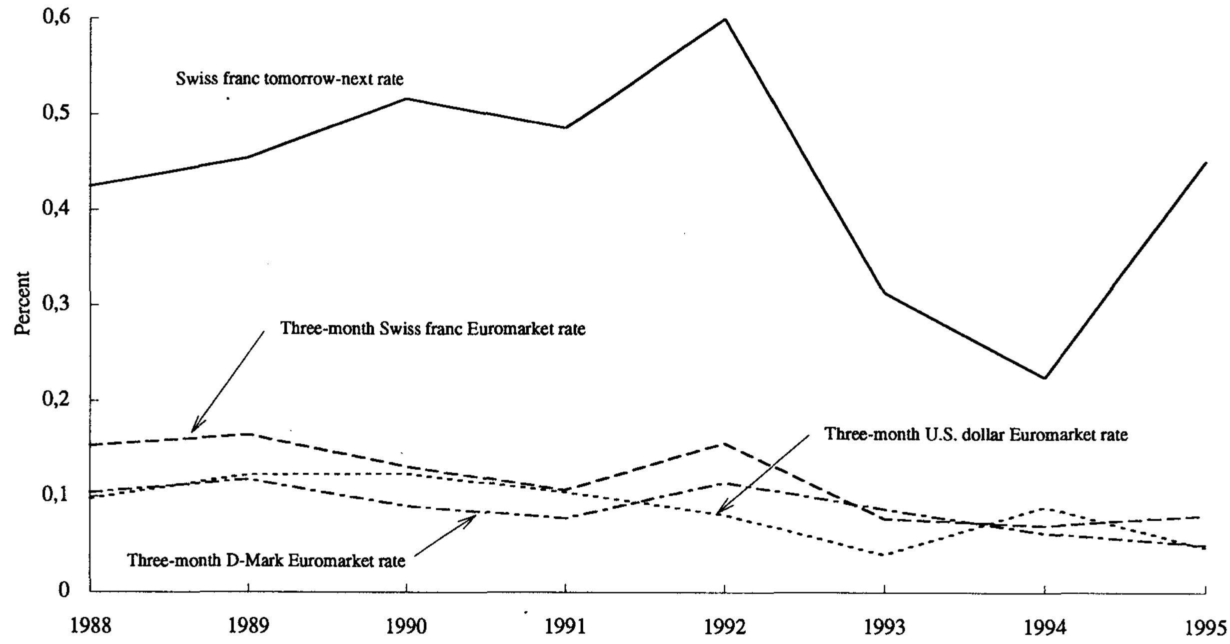


Figure 3
Volatilities of short-term interest rates
Standard deviation of daily observations from a thirty-day moving average



Conclusion

To conclude, we wish to note certain advantages of the special Swiss operating procedures, featuring a quantitative operational target that is pursued, however, with some interest rate considerations in mind:

- Tolerating volatility of overnight money market interest rates leaves the markets with some uncertainty. Hence, they may not costlessly test interest or exchange rate target levels which, from time to time, markets think exist in the mind of the SNB.
- A quantitative operating target like ours can also be rationalised by the following reason: central banks appear to be inclined to conduct a policy of leaning against the wind if they rely heavily on interest rates as indicators of monetary policy. Such a policy may be dangerous if it prompts central banks to forestall adjustments in interest rates that would actually be needed to achieve their ultimate objectives.
- A basically quantitative operating target also tends to shield a central bank from too much political pressure: movements in short-term interest rates cannot wholly be attributed to the central bank; often, they may be simply caused by market forces. This helps to avoid excessive central bank watching and pressuring by political bodies and the markets.

Looking at the market turbulences of recent months shows, however, that there may arise some problems with our approach. As has been theoretically known for a long time, shifts in demand for the quantity that one targets may result in undesirable and unnecessary interest rate fluctuations. This is why the SNB started giving more weight to interest rate considerations, at least for the time being. This shows that a purely quantitative approach to monetary procedures obviously is not a feasible option – interest rates have to play a certain role even in the framework of a basically quantitative operating procedures.

The implementation of monetary policy in Australia

Ric Battellino, John Broadbent and Philip Lowe[1]

Introduction

Over the past decade, the monetary policy framework in Australia has changed substantially, with the most significant change being the adoption of an inflation target in the early 1990s.[2] There have also been changes at the operational level. Many of these changes were part of an evolutionary process following the deregulation of financial markets in the first half of the 1980s, but a major change occurred in January 1990 when the Reserve Bank began to announce changes to the stance of monetary policy, as reflected in the level of overnight interest rates. Prior to that, it simply operated in the market and left market participants to draw their own conclusions about policy changes. One consequence of this move to announcements was that interest rate changes are now implemented as discrete, and fairly large, steps.

This paper discusses some of the thinking behind these changes in operating procedures and the effects that they have had on financial markets and the transmission mechanism. The paper is structured as follows. Section 1 describes the main features of current operating procedures. Section 2 discusses the reasons why the Bank adopted these arrangements. Section 3 then examines the impact of the changed procedures on financial markets, including the effects on interest rate volatility, market turnover, and the speed with which financial institutions adjust their deposit and lending rates. Finally, Section 4 makes some concluding comments, and foreshadows possible changes to market operations that will result from the move to real-time gross settlement next year.

1. The Australian framework for implementing monetary policy

1.1 Current operating procedures

Domestic market operations became the main mechanism for implementing monetary policy in Australia in the mid 1980s, as part of the general trend towards deregulation. The immediate objective of these operations is the overnight interest rate (also known as the "cash" rate), which is the instrument of monetary policy. Since 1990, the Bank has announced an operational target for the cash rate (expressed as a single figure) each time monetary policy is changed.

Market operations influence the cash rate by changing the availability of banks' "settlement" balances – that is, the funds used by banks to settle their payments obligations. These settlement balances are held in banks' Exchange Settlement Accounts at the Reserve Bank, and do not count towards reserves held for the purpose of meeting reserve ratios.[3] Interest is paid on settlement balances at a rate 10 basis points below the Bank's target for the cash rate.

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1 We would like to thank Eleanor Lewis and Tim Rocks for invaluable research assistance.

2 The Bank's inflation objective is to achieve an average rate of inflation of between 2 and 3% over the course of the business cycle. This objective has been formally endorsed by the Federal Government.

3 The reserve ratio on banks is set at 1% of liabilities. The reserve requirement is determined each month in relation to the previous month's average liabilities. This reserve ratio currently has no monetary policy significance, but effectively acts as a tax on banks (they are paid a rate of interest 5 percentage points below the market rate).

Exchange Settlement Accounts must be in credit at all times, so banks seek to maintain sufficient funds in these accounts to meet their daily settlement needs – i.e. the demand for these reserves is essentially a transactions demand, and is quite well defined. Any tendency for reserves to move away from the level that banks regard as desirable quickly results in pressure on the cash rate as banks attempt to restore their holdings to the desired level. The fact that banks earn a rate of return on their settlement balances which is only a small margin below the overnight rate means that downward pressure on rates is limited.

The Bank's market operations are conducted in Commonwealth Government securities (the securities issued by the Federal Government). They involve both outright trading and repurchase agreements, though the latter account for about 90% of transactions. At times, the Bank supplements these operations with foreign currency swaps.

Any participant in the wholesale market for government securities is eligible to deal with the Bank.[4]

Inter-bank settlement is on a net, deferred (next-day) basis.[5] This means that the "exogenous" factors which affect the banks' cash position are largely known at the start of each day. The Bank publishes this estimate of the cash position at 9.30 am each day, together with its dealing intentions for the day (whether it will buy or sell, though not the amounts). Announcements of monetary policy changes are also made at this time. Dealing operations are conducted later in the morning, around 10.30 am. Because the market cash position is known at the start of the day, the Bank usually needs to engage in only one round of dealing each day to maintain the required degree of reserve pressure.

Should, for some reason, banks wish to obtain additional reserves to those supplied by the Bank in its morning dealing round, they (and any other market participant) may rediscount Treasury notes at the Reserve Bank at their discretion. A substantial penalty applies to rediscounts (75 basis points over market yields) and, given that the cash rate rarely diverges from the target by this margin, the rediscount facility is used very infrequently.[6]

1.2 History of policy announcements

Prior to January 1990, the Bank did not announce its monetary policy stance when changes were implemented; instead, market participants assessed the stance of policy from the Bank's actions in money markets and from changes in the overnight interest rate. Under this arrangement, changes to policy were not always immediately obvious to the market due to noise in the overnight rate.

This method of operation was common to a number of countries at that time. After the difficulties experienced with administered interest rates in the 1970s, central banks saw advantages in implementing monetary policy through market operations and in having some volatility in short-term interest rates; in particular, this was seen as providing some flexibility in policy implementation – e.g. there was scope to start "snugging" rates higher, and then reverse, if subsequent data did not support the move. This arrangement was seen as allowing central banks to take timely action, particularly in raising rates, as it avoided the risk of having to announce reversals of policy which could be damaging to credibility. To the extent that volatility in interest rates encouraged a public perception that markets

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4 Prior to June 1996, the Bank's dealing counterparties were restricted to a group of authorised money market dealers (discount houses).

5 Australia is scheduled to move to a real-time gross settlement payments system at the end of 1997.

6 For more detail on the history of the Bank's domestic market operation, see Rankin (1992 and 1995) and Battellino (1990).

set financial prices, it was consistent with the then prevailing view that central banks should focus on quantities rather than setting financial prices.

In January 1990, the Bank decided to ease policy after a prolonged period of very tight monetary conditions in the late 1980s. There were concerns about how this would be received in financial markets. For one thing, the change marked a reversal of a process of policy tightening that had been going on for about two years. The decision was also somewhat pre-emptive, and therefore ahead of a clear consensus in the market about the need for an easing. The situation was further complicated by the fact that a federal election was imminent, and there was a risk that in the circumstances the easing could have been interpreted as being politically motivated. For these reasons, it was felt that the Bank should make a public explanation of the policy change.

This initial announcement was made mid morning, at the end of the Bank's dealing session for that day and as market interest rates began to fall. The announcement was successful and a similar approach was followed in the subsequent easing. The practice of announcing each policy change has continued since, with the timing being brought forward to the start of the day – i.e. ahead of the Bank operating in the market.

The decision to make announcements brought with it the need to make explicit the size of the change in interest rates. Initially, the Bank gave a range for the cash target, on the grounds that it was not sufficiently confident that it could immediately achieve a precise target. In the event, however, the Bank soon found that its control over the cash rate had increased under the new arrangements, and it therefore began to announce a single target rate. As time went on, market dynamics changed further, with the cash rate moving quickly to the new target on the announcement – i.e. ahead of the Bank operating in the market for the day.

The effect of the change in operating procedures on the speed of adjustment of the actual cash rate to changes in the target rate has been estimated using the following error-correction model:

$$\Delta r_t = \alpha + \sum_{i=1}^{K} \beta_i \Delta r_{t-i} + \sum_{i=0}^{L} \gamma_i \Delta \bar{r}_{t-i} + \lambda r_{t-1} + \phi \bar{r}_{t-1} + \varepsilon_t$$

where r_t is the actual cash rate and $\bar{r}_t$ is the target cash rate.[7] The equation was estimated using daily data and over two time periods: the first running from 1st July 1985 to 22nd January 1990 (the day before the first announcement) and the second from 23rd January 1990 to 2nd September 1996. In estimating the equations we initially included seven lags of the changes in both the actual and target cash rate and then used the general-to-specific methodology to obtain a more parsimonious specification. The estimation results are reported in Appendix 1.

As expected, the estimates for both periods indicate that eventually changes in the target cash rate are fully reflected in the actual cash rate. There are, however, important differences in the two sets of results. First, in the earlier period the absolute daily changes in the cash rate were much larger and much less well explained by movements in the "target rate". Second, in the period in which announcements have been made, the actual cash rate has adjusted more quickly to the target rate. By the day after the change in the target rate, the adjustment is complete with the vast bulk of the adjustment occurring on the day of the policy change.[8] In contrast, in the earlier period the point estimates suggest that if the "target rate" was changed by 100 basis points, the actual rate would move

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7 In the period prior to January 1990 when there was no official target for the cash rate, we have used the midpoint of the informal band that guided the operations of the Bank's domestic trading desk.

8 Prior to the Reserve Bank paying interest on settlement balances, there were opportunities for banks to earn a small profit around the time of the change in policy by attempting to adjust their level of float; i.e. the net obligations arising from unsettled cheques. Because the interest rate paid on the float was based on the average cash rate for the week, a change in policy late in that week meant that banks had some scope to arbitrage between the overnight rate and the float rate, which could slow down the adjustment of the overnight rate to the new target.

by only 26 basis points on the day of the change; after one week the actual rate would have moved by around 50 basis points, and after one month, by around 90 basis points.

2. The thinking underlying current arrangements

2.1 The case for announcements

Looking back, the Bank's view is that there have been significant net benefits arising from the practice of making announcements. Essentially these rest on the now well documented arguments for central bank accountability. Among the specific benefits:

- The discipline of having to explain to the public the reasons for policy changes has led to greater rigour in the Bank's internal policy debates, and a clearer focus on the objective of the policy change.
- Clear statements of the reasons for policy changes have led to greater community acceptance of monetary policy decisions, and a better understanding in the community of the Bank's objectives. As a by-product, it has enhanced perceptions of the Bank's independence, as the community now more fully appreciates the Bank's responsibilities for monetary policy decisions.
- There are some signs that it has improved the transmission of monetary policy. There appears to be a more direct psychological impact on households and businesses, and the pass-through to bank interest rates is noticeably faster, particularly when monetary policy is being tightened. The reasons here are two-fold. First, recognition lags – i.e. the time it takes the market to discern a change in policy – have been eliminated. Second, there is more pressure on banks to respond to a publicly announced change in policy than was the case when policy changes were discernible only to professional market participants.[9]

The process of announcing changes to the cash rate target has some of the same characteristics as a system of administered interest rates, and there was therefore some concern, when the Bank decided to make policy announcements, that it would reduce flexibility. In particular, it could lead to greater reticence in implementing policy changes and thereby increase response lags. In the event, however, this concern has proved unfounded.

Overall, the move by the Bank to announce and explain each policy change is seen, both in the Bank and in the community at large, as being a positive development and it would be difficult to envisage circumstances in which the Bank would now move away from this practice.

2.2 The pattern of interest rate changes

Since 1990, there have been 20 changes in monetary policy – fifteen easings between 1990 to 1993 as the overnight interest rate was reduced from 18 to 4.75 %; three tightenings in the second half of 1994; and two easings in the second half of 1996. Of these, one involved a change in the cash rate of 150 basis points; eleven involved a change of 100 points; two involved a change of 75 points; and six involved a change of 50 points.

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9 Caplin and Leahy (1996) argue that a single large reduction in interest rates may be more effective than a sequence of small reductions, as small reductions lead investors to expect further cuts with the consequence that they delay their investment. They argue that "policy needs to be more aggressive than the reaction it seeks to elicit" (p. 699).

These changes in the overnight interest rate have generally been larger than is the case in many other developed countries; on average, the size of moves has tended to be about twice as large as those in other English-speaking countries (see Table 1).

Table 1
International comparison of changes in interest rates

Country	**Latest tightening cycle (1994)**			**Latest easing cycle (1995-96)**		
	Number of changes	**Total change (basis points)**	**Average change (basis points)**	**Number of changes**	**Total change (basis points)**	**Average change (basis points)**
Australia	3	275	92	2	100	50
United States	7	300	43	3	75	25
Canada	10	450	45	20	500	25
United Kingdom	3	150	50	4	100	25

Despite the larger size of moves, interest rates have typically been adjusted multiple times in the same direction before a move is made in the other direction, a pattern which is common to most countries.[10] The Australian experience is summarised in Table 2. Using data on the "target" cash rate, we characterise each interest rate change as a "continuation" or a "reversal", where a "continuation" is a movement of the target rate in the same direction as the previous change, while a "reversal" is a move in the opposite direction. The table shows that over the past decade the number of continuations is almost four times that of reversals. Over the period in which changes in the target rate have been announced, the ratio of continuations to reversals is even higher, reflecting the long series of reductions in interest rates in the early 1990s.

Table 2
Interest rate changes in Australia

	Number of changes	**Average size (basis points)**	**Average number of days since previous change**
January 1985 - November 1996			
- Continuations	38	94	72
- Reversals	9	122	185
- Total	**47**	**99**	**94**
January 1990 - November 1996			
- Continuations	17	87	88
- Reversals	3	75	372
- Total	**20**	**85**	**130**

10 See, for example, Goodhart (1996) and Rudebusch (1995).

Table 2 also shows the average size of the movements in the cash rate and the average numbers of days between movements. There is no systematic difference in the average size of reversals and continuations, but as the time lengthens since the previous policy adjustment, the probability that the next move will be a reversal appears to increase.[11]

The relatively large number of continuations suggests that interest rate changes are positively autocorrelated. This positive correlation appears to be strongest for quarterly changes in interest rates – over the entire period from January 1985 to August 1996 the correlation between the quarterly change in the target cash rate and the change in the previous quarter is 0.53. In interpreting this correlation, it needs to be kept in mind that the period since the late 1980s was one in which Australia experienced a long-term decline in inflation, and hence also in interest rates, which would have contributed to the autocorrelated outcomes.

The positive autocorrelation of quarterly interest rate changes implies that changes are predictable, in the sense that the probability of an interest rate increase and the probability of a decrease are not always equal. Any predictability of changes in policy interest rate has been criticised by economists who argue that the authorities should set the interest rate so that the probability that the next move is up is equal to the probability that it is down. This argument is typically based on a model which sees a very restricted role for monetary policy. For example, Barro (1989) argues that the monetary authority's task is simply to move the nominal interest rate in line with the equilibrium real rate, which is constantly changing in an unpredictable fashion. As a result, changes in the nominal rate should also be unpredictable.

In contrast, if the equilibrium real rate is constant, or varies around some (constant) average, movements in policy interest rates will sometimes be predictable. Suppose, for example, that the central bank raises nominal (and real) interest rates to combat an inflation shock. At some point in the future, one would expect that interest rates would need to be lowered, otherwise the real interest rate would be permanently higher. Given such an expectation, it cannot be true that the interest rate is always set at the point where the expected change over any future period is zero. Put simply, if there is an equilibrium nominal interest rate and the current rate is not at the equilibrium, interest rate changes will, to some degree, be predictable.

This predictability implies that interest rate moves away from equilibrium will be followed by reversals; it does not imply multiple movements of the policy interest rate in the same direction. Interest rates could be moved up in response to a shock and then moved back down in a single step to their initial value. This is the pattern that Goodhart (1996) has in mind when he argues that an important explanation for the persistence of inflation is that central banks "do not vary interest rates sufficiently aggressively, or promptly, to hold inflation to a desired path". The argument is that by delaying interest rate moves, or by moving by too small an amount, central banks are eventually forced to make further moves in the same direction. Goodhart argues that if a central bank was pursuing an inflation objective, the level of the official interest rate should be random (around some constant mean), so that only the next move (back to the mean) would be predictable.

In contrast, Blinder (1995) has implicitly argued that a sequence of predictable interest rate movements represents optimal behaviour, stating that "a little stodginess at the central bank is entirely appropriate" (p. 13). He suggests that central banks follow a strategy in which movements in interest rates are smaller than optimal, but are followed up with subsequent movements if things work out as expected.

[11] Rudebusch's (1995) analysis of changes in the federal funds rate between 1974 and 1992 suggests that in the first couple of weeks after a change there is a higher probability that the next move will be in the same direction, rather than in the opposite direction. After four weeks the probabilities are broadly equal.

There has been little formal justification for why central banks might act in this way.[12] As a consequence, the remainder of this section is devoted to discussing possible explanations of the observed pattern of interest rate changes (other than sub-optimal behaviour of the central bank). The most plausible explanations have their roots in the uncertainties that policy makers face.

2.3 Reasons why central banks engage in interest rate smoothing

There are three broad lines of argument why central banks may want to smooth interest rate changes:

- slow adjustment of interest rates represents the optimal response to shocks, even when there are no costs of adjustment;
- when there are adjustment costs, slow adjustment of interest rates reduces these costs; and
- slow adjustment of interest rates is due a combination of uncertainty and the costs incurred in changing the *direction* of interest rates.

2.3.1 Slow adjustment can be optimal

It is sometimes argued that the positive autocorrelation of interest rate changes is *prima facie* evidence that central banks are not doing their job properly; that they are not moving aggressively enough to offset shocks. Certainly, one can build simple models which predict that a central bank with an inflation target will deliver uncorrelated interest rate changes (Goodhart (1996) and Barro (1989)). However, slight variations to these models can deliver systematically positively autocorrelated interest rate changes (see Appendix 2). The critical issue is whether the economy responds to a change in interest rates in the same way as it does to various other shocks. The model in Appendix 2 illustrates that if the response patterns are sufficiently different, moving interest rates multiple times in the same direction may represent the optimal policy response to a shock.

2.3.2 Adjustment costs

If interest rates are costly to adjust, it may be sensible for central banks to move gradually to their desired target. The critical point is that the costs must be increasing at an increasing rate in the size of the adjustment. If so, moving in small steps minimises the total adjustment costs. In contrast, if there is simply a *fixed* cost of adjusting interest rates, small adjustments will be ruled out, but so too would be multiple moves.

One reason why central banks might avoid moving in one large step to the estimated new desired interest rate is that this could be very disruptive in financial markets, and could even threaten the stability of the financial system.[13] Large unexpected changes in funding costs and securities prices could undermine financial institutions. One caveat to this line of reasoning is that, in principle, a

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[12] There is, however, an extensive literature on the issue of whether monetary policy should smooth interest rates in the face of changes in money demand, with Poole (1970) being the seminal article. For example, Mankiw and Miron (1991) have examined the issue of whether central banks should smooth interest rates in the face of seasonal changes in the demand for money. Mankiw (1987) and Barro (1989) have also argued that maintaining a smooth interest rate may be optimal from the point of view of smoothing the inflation tax. There is also an extensive literature on the implicaitons of interest rate smoothing for tests of the expectation theory of the term structure (for example, see Rudebusch (1995), Balduzzi, Bertola and Foresi (1993) and McCallum (1994)).

[13] A version of this argument is made by Cuikerman (1991). He argues that in the US, the maturity mismatch between banks' assets and liabilities means that the Fed wishes to partially offset unanticipated increases in interest rates. The smaller is the maturity mismatch, the smaller is the incentive to smooth rate changes.

small change in interest rates which is accompanied by expectations of further moves should have a similar effect on long bond yields as a large, one-off move. However, in practice, it is questionable whether this is the case, as many financial prices appear to react slowly to news. Recent experience suggests that even though a sequence of policy changes is expected, the full reaction in financial markets does not occur up front, but gradually over the period of adjustment of policy interest rates. Partly as a legacy of the history of relatively small movements, large up-front changes in policy interest rates risk causing much larger short-run movements in securities prices. Even without this history, large unexpected changes in policy interest rates probably add to financial market volatility, and in some cases concentrate the losses in particular institutions, ultimately threatening the stability of the financial system.

Similar issues arise for households and businesses. A gradual adjustment in policy interest rates can provide breathing space for borrowers to re-arrange their financial affairs, so that the liquidity effects of a change in interest rates are not as dramatic. This line of argument is obviously more relevant in financial systems in which variable-rate debt plays a significant role.

2.3.3 Uncertainty and costs of reversals

The most persuasive argument for moving gradually is that monetary policy is made under considerable uncertainty. Policy makers do not know the true model of the economy, they do not know the exact impact that a change in interest rates will have on activity and inflation, and it can be difficult to assess the current state of the economy.

Uncertainty about the model

Blinder (1995) notes that uncertainty regarding the value of the parameters in the policy-maker's model justifies making smaller interest rate movements than would otherwise be the case. The idea, based on earlier work by Brainard (1967), is that as the interest rate is moved further away from its average value, policy makers become more uncertain about how a change in the interest rate will affect their objectives. This increased uncertainty reduces the optimal size of the policy move.

While the idea provides a convincing rationale for policy makers being cautious in changing interest rates, it does not provide a complete explanation for multiple moves in the same direction. It could only do so if, after having moved the interest rate, the central bank learns some information which reduces the degree of parameter uncertainty. The gradual reduction in uncertainty would then lead to multiple moves towards the target rate. A difficulty with this argument is that the time between movements in policy interest rates is often too short for there to be any significant reduction in the degree of parameter uncertainty.

Uncertainty and costly reversals

Another model of the effects of uncertainty is suggested by the work stimulated by Dixit (1989).[14] In attempting to explain the slow evolution of the capital stock to its optimal level, Dixit proposed a model which considered the interactions of:

(i) uncertainty about future returns;

(ii) the irreversibility of investment projects;[15] and

(iii) the possibility of delaying investment.

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[14] For a comprehensive review see Dixit and Pindyck (1994).

[15] More recent models have allowed investment to be reversed, but at a cost (see Abel et al (1996)).

The analogy to monetary policy is clear:

(i) policy makers are uncertain about the future state of the economy;

(ii) changes in the direction of interest rates are seen as costly; and

(iii) there is always the possibility of delaying an interest rate change until the policy maker has more information.

The investment literature makes the point that the ability to delay investment decisions can profoundly affect the decision to invest today. If there are costs of reversing an investment, making a decision to invest today involves giving up the option of waiting for new information, and perhaps making a better decision tomorrow. As a result, it may be optimal to delay investment, or to make a smaller investment and subsequently increase its size if the uncertainty is resolved in the direction that was expected. While a delay in investment is a common prediction of these models, Abel et al (1996) note that other outcomes are possible. For instance, if the cost of future investment is expected to rise, delaying an investment may be sub-optimal even in the presence of considerable uncertainty.

For these insights to apply to monetary policy, changing the direction of interest rate movements must be costly – that is, there must be a cost to "reversing the investment". The costs might arise in terms of additional volatility in financial markets and potential damage to the central bank's reputation.

To investigate the issue of whether changes in the direction of the cash rate lead to greater short-term volatility in security market yields we estimate the following equation:

$$|\Delta i_t| = \alpha + \beta |\Delta \bar{r}_t| + \delta\, REVERSAL_t + \varepsilon_t$$

where i_t is either the 90-day bank bill rate or the 10-year bond rate, $\bar{r}_t$ is the target cash rate and *REVERSAL* is a dummy variable that takes a value of 1 if there is a reversal of policy on that day, and takes a value of zero otherwise. We use daily data and restrict the estimation period to the period over which announcements have been made. The results are presented in Table 3. If policy reversals cause increased volatility in the yields on 90-day bills or 10-year bonds the coefficient on the *REVERSAL* dummy variable should be significant and positive.

Table 3

Interest rate changes and market interest rates: regression results

	90-day bills	**10-year bonds**
Intercept (α)	3.2	6.5
	(0.1)	(0.2)
Absolute change in target rate (β)	0.209	0.003
	(0.013)	(0.017)
Dummy for reversal (δ)	6.2	14.7
	(2.9)	(3.8)
$\bar{R}^2$	0.16	0.01
Number of observations	1,678	1,678

Notes: Standard errors are in parentheses below coefficient estimates. Sample period is from 23rd January 1990 to 2nd September 1996. Interest rates are expressed in basis points.

In both equations, a change in the direction of monetary policy appears to be associated with a larger than average movement in the market interest rate, with the effect being particularly pronounced for the 10-year bond yield. The estimates suggest that on days when policy is moved in the opposite direction from the previous move, bond yields have tended, on average, to move by an additional 15 basis points; for bill rates the figure is 6 basis points. This larger movement occurs despite the fact that the change in direction was not always unexpected. The results also confirm that the larger is the change in the cash rate, the larger the change in the bill rate. This suggests that large changes in policy interest rates would induce more volatility into the short end of the yield curve. There appears to be no such effect at the longer end of the curve. While it is difficult to draw strong conclusions due to the small number of reversals in the sample period, the results suggest that policy reversals increase short-term volatility across the yield curve. This issue is a topic for future research.

A more difficult issue to evaluate is whether this additional volatility is itself costly. Perhaps more difficult still is the issue of whether reversals would continue to generate additional volatility if they were more frequent. If reversals occurred as often as continuations, would they be less newsworthy and would they invoke a smaller reaction from the market? Or would the frequent reversals undermine confidence in the central bank, ultimately leading to greater volatility in financial markets?

The issue of how frequent reversals might affect the credibility of the central bank has importance beyond the implications for financial markets. If frequent changes in the direction of interest rates undermine public confidence in the central bank, inflation expectations might be higher than would otherwise be the case and the climate for investment may be adversely affected.

In Australia, as in all developed countries, changes in interest rates attract considerable public attention; on the day of the change, it is usually the leading story in the media. The Reserve Bank's practice of announcing and explaining interest rate changes has tended to make policy changes more newsworthy, which may have made frequent changes in the direction of interest rates more difficult. In the absence of clearly defined shocks (such as a large exchange rate change) it may be difficult for the central bank to make the case to the public that interest rates should be lowered one month, raised the next, and then lowered again a month later. Regardless of whether or not such a policy was "optimal", the public would probably see the central bank as indecisive. As discussed earlier, the flexibility to change direction without adverse effects was an important reason why many central banks in the 1980s did *not* announce changes to policy.

While announcements might make reversals more difficult, they have significant benefits in terms of accountability and the transmission mechanism. These benefits currently outweigh any reduced flexibility that might be associated with the announcements. However, the need to minimise the probability of costly reversals means that some caution is called for in moving rates. By making a smaller change, policy makers can reduce the probability of having to make a costly reversal. If developments turn out as expected, policy can be moved again in the same direction; if the unexpected happens and it turns out that no change in policy was required, the costs of reversing policy are saved. The end results of waiting for uncertainty to be partly resolved are systematically positively autocorrelated interest rate movements and positively autocorrelated inflation and economic activity.

The major qualification to this line of argument arises if the size of the required policy adjustment depends upon the speed and magnitude of the initial policy adjustment. Suppose a delay in adjusting policy to an inflationary shock led to inflation expectations rising. The end result would be much higher interest rates, as the central bank struggled to reverse the rise in expectations of future inflation. In this case, an early and large increase in interest rates may be warranted, despite the fact that an increase of this type increased the probability that the policy move would have to be reversed.

Finally, the stronger is a central bank's inflation record, the longer may be the period it can wait before adjusting policy. If the central bank has high credibility, inflation expectations are less likely to adjust up, and this should give the authorities more scope to wait and to assess the exact nature of the shock and the appropriate policy response. In so doing, increased credibility might provide more scope for the central bank to avoid costly reversals of policy.

Uncertainty and the decision making process

A third way that uncertainty contributes to the positive autocorrelation of interest rate changes is the impact that it has on the decision-making process. There is rarely unanimity among experts concerning the exact magnitude of necessary monetary policy adjustments. Many of the differences of opinion arise from the uncertainty regarding the current state of the economy, the exact nature of shocks and the exact structure of the economy and the associated policy multipliers. Decision making by committee creates an environment in which the various views can be discussed and reduces the probability that extreme decisions are made. However, committee-based decision making can also systematically affect the way policy responds to shocks. It can lead to compromise solutions which involve a smaller initial change in interest rates followed up by a further increase, when the case becomes more compelling.

A related issue is that monetary policy needs to be broadly acceptable to the community as a whole. Again, because of uncertainty about the future, it may be difficult to convince the community that a large interest rate change is the appropriate response to a shock. The case for such a change is likely to depend heavily on the central bank's forecasts for activity and inflation. These forecasts might differ from those of other forecasters and the public may not be convinced that the large change in interest rates is required. With little history of large one-off interest rate movements, the public in most countries is unlikely to find such movements acceptable. The ability of the central bank to convince the public of the need for large movements in interest rates will depend importantly on the confidence that the central bank enjoys in the community. A record of good policy making would undoubtedly assist in this regard. But, even central banks with good records must constantly weigh up the risks of policy errors as public support can quickly be lost. As a result, to maintain a broad consensus concerning the direction of monetary policy, interest rate changes may be smaller and more gradual than would have otherwise been the case.

2.4 An assessment

Three of the defining characteristics of Australia's recent monetary policy arrangements are:

1. changes in policy interest rates have been explicit and the reasons for the change are explained in detail;
2. individual changes in policy interest rates have tended to be large by international standards; and
3. policy interest rates have typically been moved multiple times in one direction before a move in the other direction is made.

As discussed above, clear announcements are not only important from the perspective of accountability, but they also mean that interest rate changes more effectively influence people's expectations about future economic and financial conditions. In turn, the monetary transmission process should be quicker and the amplitude of the interest rate cycle smaller.

Beneficial announcement effects are more likely to be achieved if the changes in policy interest rates retain their newsworthiness. If changes in rates occur extremely frequently, or are very small, their newsworthiness is likely to be diminished, and they are less likely to force a relatively quick change in banks' posted lending rates. Changes in these rates reinforce the attention that the change in official interest rates receives. If policy interest rates were changed frequently, and/or by small amounts, the immediate link between monetary policy and lending rates might be weakened, reducing the overall effectiveness of the policy changes.

There is, however, no clear, unequivocal basis for deciding what is the optimal size and pattern of interest-rate adjustments. The decision is influenced by the expected overall move in rates that is required; by the impact that changes of various sizes will have on people's expectations; by the costs that are paid if the policy change has to be reversed; and by the degree of uncertainty. In turn, these factors will be influenced by the nature of the forces necessitating the policy change, the institutional structure of the economy and the financial system, and the historical context of policy changes.

The pattern of interest rate changes that has been adopted by the Reserve Bank of Australia is one that has delivered positively autocorrelated inflation rates. The same is true in almost all countries. While the simple models of some economists suggest that this persistence could be eliminated by changing the way in which central banks move their policy instrument, this has rarely been attempted, or achieved, in the real world. The range of uncertainties that policy makers face provide a solid explanation for the persistence of interest rates, and ultimately inflation rates. It is a question of attempting to balance the beneficial announcement effects of relatively large changes in interest rates against the costs that can arise if policy changes are frequently reversed.

3. The impact on financial markets

The move to a transparent approach to implementing policy has reduced volatility in short-term interest rates and resulted in faster pass-through of policy changes to lending and deposit rates of financial intermediaries.

3.1 Volatility in the overnight interest rate

The panels in Graph 1 show daily observations of the overnight interest rate for the period since the mid 1980s. The shaded areas in the pre-announcement period show the informal operating levels that guided market operations.

Graph 2 shows a measure of cash rate volatility over the same period.[16]

The main points to note from these two graphs are as follows:

- First, volatility tended to decline progressively in the pre-announcement period, as operating techniques were gradually refined after the start of deregulation.[17] By late 1989, just prior to formally announcing changes in policy, daily volatility had declined to around 25 basis points, compared with around 100 basis points in the mid 1980s.
- Second, after the move to formally announcing policy changes, volatility fell noticeably further. Currently, it is rare for the cash rate to deviate by more than a couple of basis points from the announced target. One of the reasons for this appears to be that market participants assume that the Bank will keep rates very close to the target rate, so that the demand curve for settlement balances tends to be very elastic around the announced rate. The tighter range for the overnight rate has not required the Bank to be more active in managing the supply of reserves. Indeed, the opposite is the case. In the pre-announcement period, around 1 in 5 daily market operations were more than

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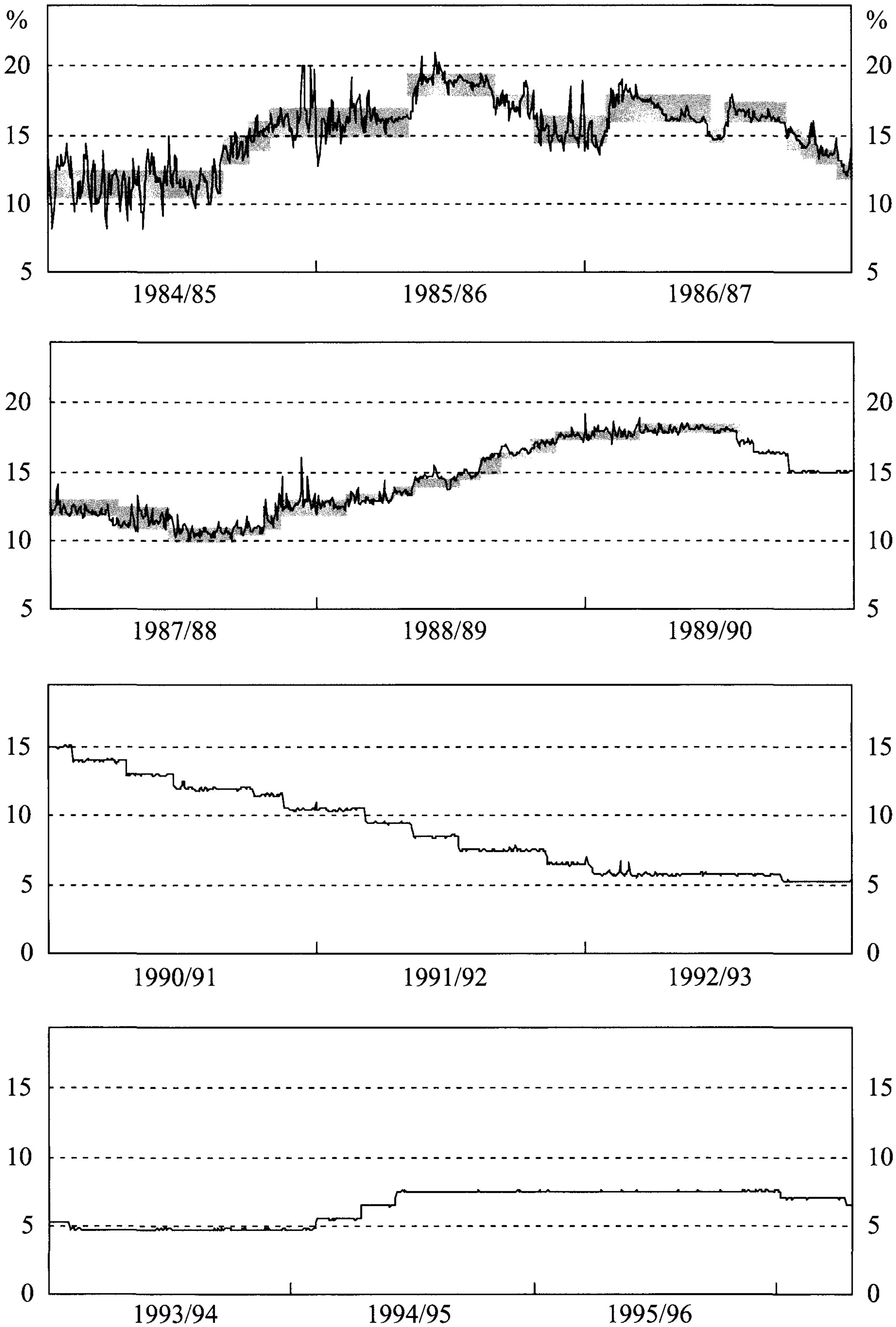
[16] For the period prior to making policy announcements, the observations represent the standard deviation of the actual daily cash rate from the centre of the band; after January 1990, volatility is measured using differences between the actual and announced cash rate target.

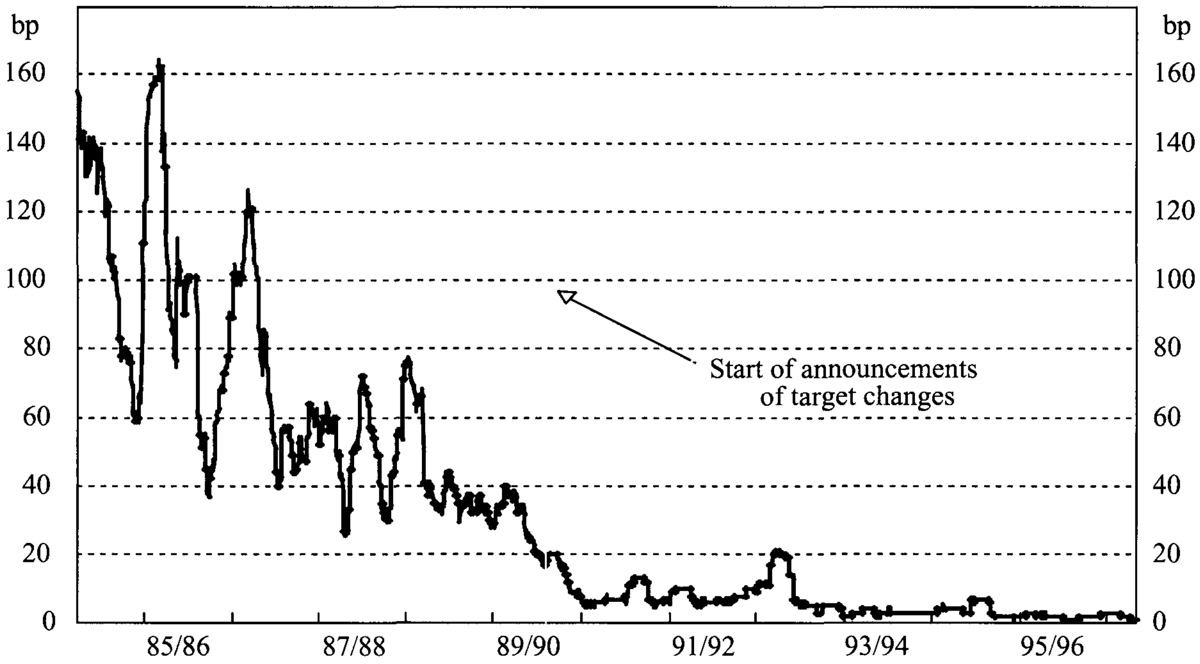
[17] Significant changes included: the start of dealing in repurchase agreements (repos) with the authorised dealers; allowing authorised dealers to deal in repos with others in the market; increasing the flexibility of the terms on which the Bank deals in repos; and the use of foreign exchange swaps.

Graph 1
Australian overnight interest rate (daily data)



one-quarter of the size of banks' settlement balances.[18] In contrast, in the post-announcement period, just 1 in 10 daily operations are associated with transactions of this magnitude.

Graph 2
Volatility in the overnight interest rate



3.2 Influence on other short-term interest rates

Short-term market yields are, of course, closely related to expectations of the future level of the cash rate. With the Bank announcing the target cash rate, and daily volatility in the cash rate much reduced, one would expect a commensurate decline in volatility in short-term yields, with yields unlikely to move significantly unless views about the future direction of monetary policy change.

The three panels in Graph 3 show, respectively, the distribution of daily movements in 30-day bill yields, 90-day bill yields and 10-year bond yields, divided into the pre- and post-announcement periods.[19] For bill yields, movements in the pre- and post-announcement periods are strikingly different. In the pre-announcement period, yields moved by more than 10 basis points on almost one in two days. In contrast, the distribution of the daily change in short-term rates in the post-announcement period tends to be much more clustered around zero. More than 90% of changes are 10 basis points or less, with rates rarely moving by more than 25 basis points on any given day. The strong implication is that much of the noise in movements in short-term rates has been removed by increasing the transparency of monetary policy actions. As expected, the change in procedures has not had a significant impact on the distribution of daily movements in bond yields. These yields are influenced more by broad domestic and international economic developments rather than by changes in cash rates.

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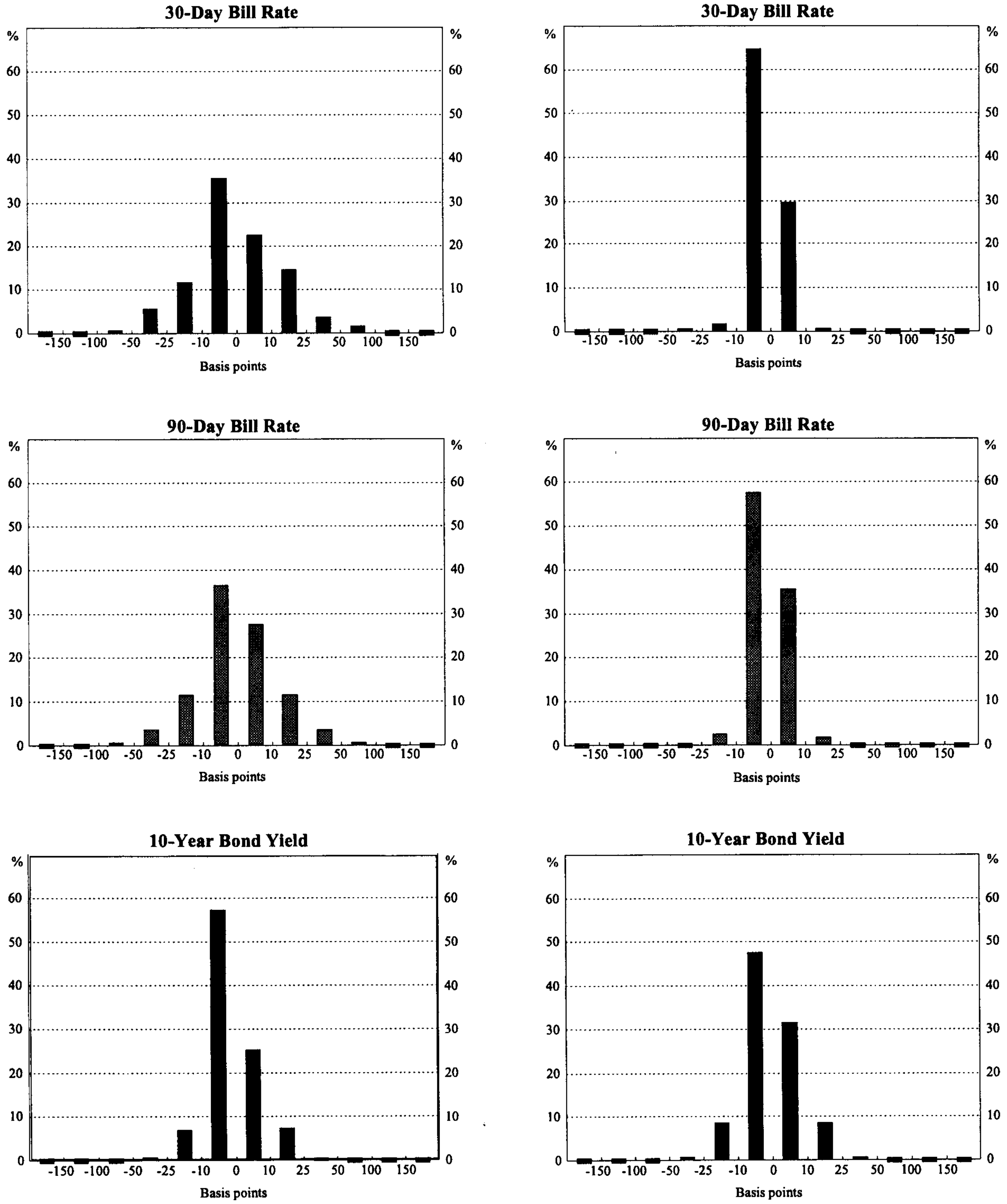
[18] Prior to July 1996, we have used banks' loans to authorised dealers as for the measure of reserve balances.

[19] The distribution for movements in 180-day bill rates is virtually the same as for other bill yields.

Graph 3
Distribution of daily movements in yields

Pre-announcement | *Post-announcement*

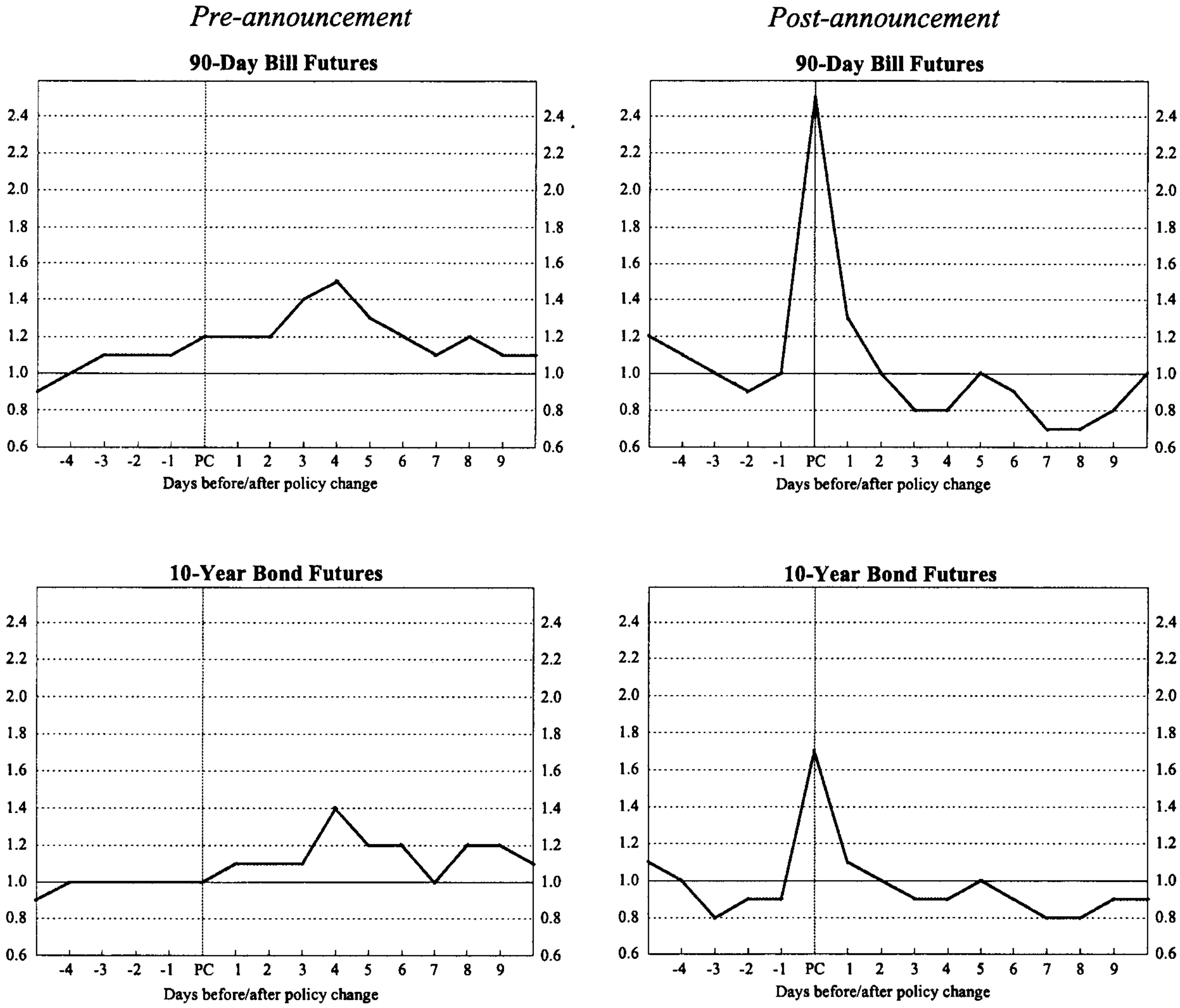


3.3 Impact on futures trading

With relatively deep and liquid futures markets in Australia, many investors find it more cost-effective to take on or unwind interest rate exposures in the futures markets, rather than buying or selling securities outright. Turnover of 90-day bill futures, for instance, is more than ten times the turnover in physical bank bills. We might expect, therefore, that the announcement of changes in policy may initially show up in the level of activity on futures exchanges.

Graph 4 shows the average volume of 90-day bill futures and 10-year bond futures contracts traded around the dates of changes in policy. Volumes have been adjusted to take account of the natural growth of the market, by expressing daily turnover as a ratio of the average daily turnover in that year. A figure around 1, therefore, implies that turnover was "average" on that day, numbers above/below 1 indicate the extent to which turnover was above/below "average".

Graph 4
Daily futures market turnover
As a ratio of annual average

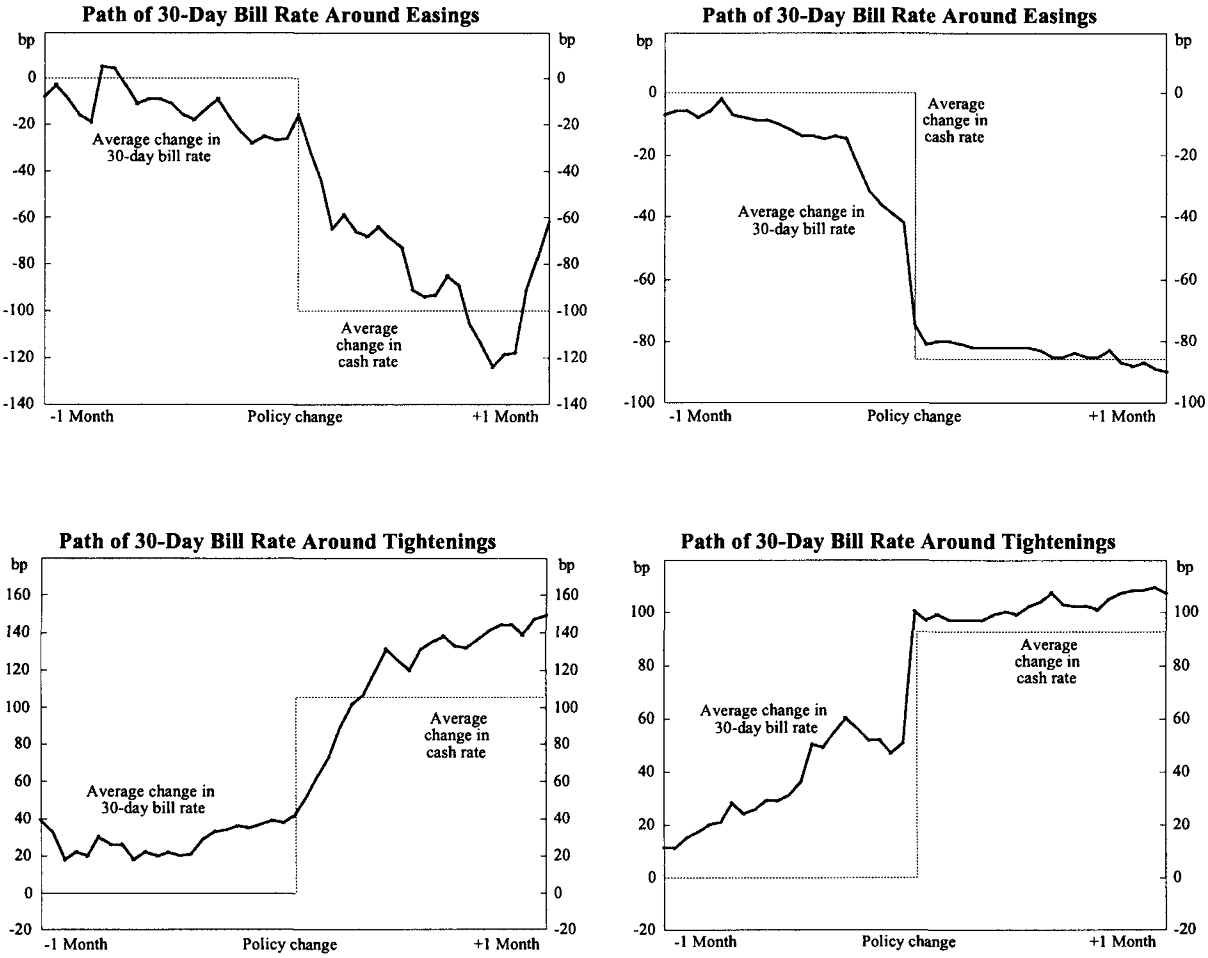


In the period when announcements were not made, there was little impact upon trading on the day when the Bank moved to implement a change of policy. This is not surprising, given that it took time for market participants to guess whether the movement in the cash rate represented a change to a new operating level or day-to-day noise around an unchanged target. Over the course of the next few days, however, it typically became apparent to the market that policy had, in fact, been changed. The market gradually adjusted, as more participants acknowledged that a change had taken place. Activity on the futures market rose, peaking at around 40 to 50% above average four days after the Bank moved to implement the policy adjustment. The adjustment continued over the course of a couple of weeks.

In contrast, the portfolio balancing occurs at a much faster pace now that policy changes are announced. Turnover surges on the day of the announcement. Trading in bill contracts is about 2.5 times larger than average, with turnover in bond contracts almost 1.8 times higher than average. There is some residual rebalancing on the day following the announcement, probably reflecting offshore investors adjusting their exposures. Turnover quickly settles to around average levels thereafter.

Graph 5
Response of 30-day bill yields to changes in monetary policy

Pre-announcement *Post-announcement*



Graph 5 shows the behaviour of the physical 30-day bill yield around the time of a change in monetary policy.[20] In the post-announcement era, expectations of a change in policy have typically built up in the month prior to the rate change, so that typically about half the adjustment has been priced into 30-day bill yields before the announcement; the change is fully priced in on the day

[20] Again, in the pre-announcement period, the mid-point of the informal band is taken as the appropriate reference point.

of the adjustment. One reason why markets now better anticipate policy changes is that, by making announcements, the Bank over time highlights the issues which are important in setting monetary policy. Market participants are therefore in a position to assess data in the economy as they become available and thereby make assessments about policy settings. In the pre-announcement period, the adjustment path was very different. The market typically priced in only a small part of the change in policy prior to its implementation. It then went on to continue adjusting short-term yields in the two or three weeks following the policy change, usually overshooting. In other words, the adjustment phase was slower and much less well-defined.

3.4 Pass-through into lending and deposit rates

In Australia, a high proportion of banking products have traditionally been priced off short-term interest rates. Most loans for housing and for business have variable interest rates, which are set by banks on the basis of the level of short-term interest rates. With policy changes now more transparent, their flow-through to deposit and lending rates could be expected to be faster. Table 4 shows the time lapse between a change in the cash rate and the movement in the 3-month deposit rate, the mortgage rate and the business loan indicator rate for each episode of policy easing and tightening over the past decade. It shows the average time it has taken banks to bring about a change in deposit and lending rates in response to changes in monetary policy.[21]

Table 4
Flow-through of changes in cash rates*
Lags in changes to deposit, mortgage and business indicator rates

	3-month deposit rate	Mortgage rate	Business indicator rate
Tightenings		*Pre-announcements*	
1985	4-5 weeks	20 weeks	9-15 weeks
1988-89	2-3 weeks	3-4 weeks	3-4 weeks
		Post-announcements	
1994	1-2 weeks	1-3 weeks	1-3 weeks
Easings		*Pre-announcements*	
1986	2-3 weeks	0	4-9 weeks
1987	2-4 weeks	7 weeks	4 weeks
		Post-announcements	
1990-93	1-2 weeks	4-5 weeks	3-4 weeks
1996	1 week	1-5 weeks	1-5 weeks

* These figures refer to the time taken for the change in rates to become effective for new customers. Lags in announcement of rate changes are significantly shorter.

The lag with which banks altered their deposit and lending rates fell substantially in the second half of the 1980s, and was reduced further in the post-announcement period. In the mid 1980s, banks took about one month to adjust deposit rates and up to 4-5 months to adjust lending rates in response to tightenings of policy. The lags were roughly halved in the tightening cycle in 1988-89 and halved again in the 1994 phase. Changes to deposit and lending rates are now moved within 1 to 5 weeks of the change in cash rates compared with upwards of 20 weeks in the pre-announcement era.

[21] An earlier paper by Lowe (1994) looked at the extent of the pass-through for the period from 1986 to 1994. He estimated that, in the medium term, the pass-through of changes in the cash rate to 3-month money market rates, housing mortgage rate and business indicator rates were 0.97, 0.65 and 0.89 respectively.

Another change is in the way banks pass through rate changes. In the pre-announcement period, business rates tended to be changed in small amounts over a long period, with changes occurring in up to 10 steps. In contrast, recent changes to cash rates have tended to be fully passed through in one step.

There are many other variables, such as the structure of banks' deposits, the riskiness of bank lending and the degree of competition in banking, that affect the extent and the speed by which changes to monetary policy are reflected in commercial banks' borrowing and lending rates. The gradual decline in banks' deposits which paid a low interest rate and increased competition from non-bank institutions in the housing market would have contributed to the faster pass-through of monetary policy changes. Nevertheless, the unambiguous signal that policy has altered has led to a much greater awareness amongst banks' customers of the extent and the speed by which changes in policy show up in changes in banks' interest rates.

Conclusion

The move to announcing and explaining changes to the overnight interest rate has brought with it a number of benefits. Market conditions are easier to manage, given that the behaviour of participants is conditioned by the fact that they do not expect the cash rate to move much away from the announced target. Benefits have spread to the wider market, including less day-to-day variability in other interest rates. Pass-through of policy changes into both deposit and lending rates has also quickened, which, together with the effect of announcements on expectations, may have contributed to a speeding up of the transmission mechanism. The announcements have also increased the transparency and accountability of monetary policy and helped to promote public understanding of the monetary-policy framework.

The announcement and explanation of movements in official interest rates has not led to increased delays in changing policy, as some had feared. In fact, the changes in operating procedures, together with the adoption of an inflation target, have seen policy become more forward looking and pre-emptive. As the experience of late 1994 illustrates, the Bank has been prepared, when appropriate, to move interest rates in quite large steps and by a relatively large amount in a short period of time. Despite this, movements in interest rates have tended to follow a relatively smooth pattern with a sequence of moves being made in one direction. While a number of factors help to explain this pattern, the most plausible explanations centre on the uncertainty that policy makers face and the costs that would ultimately be incurred if the direction of policy were to be changed too frequently.

Further changes to operating procedures will be necessary with the move to a real-time gross settlement system in late 1997. Inter-bank settlement for high-value payments, including securities settlements will no longer take place on a deferred (next-day) basis, but in real time. This will mean that the cash position of the market will not be known at the start of the day, as it is at present, and the Bank may therefore have to refine its dealing procedures. Changes are under consideration at present.

The push for greater policy transparency and accountability is a continuing one. The Governor has recently agreed to release specific statements on monetary policy, including information on the outlook for inflation, at six monthly intervals, thereby formalising commentary the Bank was providing in its Bulletin. In future, the Bank will also formally report on the conduct of monetary policy to Parliament twice a year.

Appendix 1

Adjustment of actual cash rate to target rate

The table below reports the estimation results for the following equation:

$$\Delta r_t = \alpha + \sum_{i=1}^{K} \beta_i \Delta r_{t-i} + \sum_{i=0}^{L} \gamma_i \Delta \bar{r}_{t-i} + \lambda r_{t-1} + \phi \bar{r}_{t-1} + \varepsilon_t$$

where r_t is the actual cash rate and $\bar{r}_t$ is the target and cash rate.

Daily data were used in estimation and seven lags of the changes in both the actual and target cash rate were included initially. We then used the general-to-specific methodology to obtain a more parsimonious specification. The first sample period (the "pre-announcement" period) runs from 1st July 1985 to 22nd January 1990. The second period (the "announcement" period) runs from 23rd January 1990 to 2nd September 1996.

Regression results

	Pre-announcement period	**Announcement period**
Constant	0.29 (0.09)	0.00 (0.00)
Δ in cash rate {t-1}	-0.20 (0.06)	0.00 (0.04)
Δ in cash rate {t-2}	-0.19 (0.05)	-0.03 (0.04)
Δ in cash rate {t-3}	-0.14 (0.04)	-0.09 (0.04)
Δ in cash rate {t-4}	-0.12 (0.05)	..
Δ in cash rate {t-5}	-0.03 (0.04)	..
Δ in cash rate {t-6}	-0.08 (0.03)	..
Δ in target rate	0.26 (0.08)	0.81 (0.05)
Δ in target rate {t-1}	..	0.07 (0.04)
Δ in target rate {t-2}	..	0.03 (0.04)
Δ in target rate {t-3}	..	0.08 (0.04)
Target rate {t-1}	0.22 (0.03)	0.47 (0.07)
Cash rate {t-1}	-0.22 (0.03)	-0.47 (0.07)
$\bar{R}^2$	0.21	0.66
Standard deviation of cash rate changes	0.60	0.10

Note: Standard errors are in parentheses below coefficient estimates.

Appendix 2

A model of interest-rate adjustment

Huang and Goodhart (1996) present a simple model in which the policy interest rate varies randomly around a constant mean. Their starting point is the following inflation process:

$$\pi_t = \alpha + \phi\pi_{t-1} - \gamma I_{t-1} + \mu_t \tag{A1}$$

where π is the inflation rate, I is the policy interest rate and μ is a serially uncorrelated shock to inflation.[22] One could think of this shock as an "exogenous" change in the exchange rate or wages. In this model, inflation is persistent and interest rates affect inflation with a lag. The central bank is assumed to know with certainty that this model represents the true inflation process, and it also knows the parameters with certainty. The objective of the bank is to minimise the expected discounted squared deviations of inflation from some desired level (π^*); that is, it minimises:

$$E\sum_{t=1}^{t=\infty} \lambda^t(\pi_t - \pi^*)^2 \tag{A2}$$

subject to equation (A1). Without loss of generality we assume that π^* is equal to zero. Solving the model, the optimal interest rate at any point in time is given by:

$$I_t = \frac{\alpha + \phi\mu_t}{\gamma} \tag{A3}$$

This rule means that the central bank sets the interest rate at the point where in expectation it achieves its inflation objective. Given that μ is a random variable, the level of the interest rate is also a random variable (around a constant mean), with past movements providing no information regarding the future level of interest rates. This leads Huang and Goodhart to conclude that in a model with persistence and lags, and with the central bank caring only about inflation, there should be no interest rate smoothing.

Now consider what happens when we change the inflation process to the following:

$$\pi_t = \alpha + \phi\pi_{t-1} - \gamma I_{t-1} + \mu_t + \beta\mu_{t-1} + \theta\mu_{t-2} + \eta\mu_{t-3} \tag{A4}$$

The change here is that the shocks to inflation have different dynamic effects on inflation than do changes in the interest rate. For particular values of the parameters, this model allows the inflationary impact of the shock to build over time and then to dissipate.

22 All parameters are assumed to be non-negative and the policy interest rate is chosen after the shock is known.

In this model the optimal interest rate rule is given by:

$$I_t = \frac{\alpha + (\phi + \beta)\mu_t + \theta\mu_{t-1} + \eta\mu_{t-2}}{\gamma} \tag{A5}$$

and the autocorrelation of interest rate changes by:

$$E[\Delta I_t \Delta I_{t-1}] = \left[\frac{\sigma}{\gamma}\right]^2 \left\{-[(\phi + \beta)(\eta - \theta)]^2 + (\phi + \beta)\eta\right\} \tag{A6}$$

where σ is the standard deviation of the inflation shock.

Under some sets of parameters, the optimal interest rate response to an inflation shock is to increase the interest rate twice and then to reduce it in two steps back to its initial value – similar to the general pattern observed in practice. Whether or not such a pattern generates positively correlated changes in interest rates on average again depends upon the particular parameters. If η and θ are close in magnitude, then interest rate movements are likely to exhibit positive autocorrelation. In contrast, if η is zero, the correlation between interest rate changes will be negative.

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Aspects of Canadian monetary policy conduct in the 1990s: dealing with uncertainty

Kevin Clinton and Mark Zelmer

Introduction and conclusions

This paper examines the conduct of monetary policy in Canada following the disinflation of the early 1990s. Since 1992 the inflation rate has generally been stable and below the centre of the inflation target range.[1] The Bank of Canada has not sought further disinflation, and monetary conditions have eased substantially. Even so, economic activity has remained quite weak, with persistently high excess capacity and unemployment. This was not expected to happen. Standard macroeconomic models incorporating an expectations-augmented Phillips curve predict that, following a period of disinflation, the economy will grow rapidly until output returns to its potential level.

This raises the question: given that inflation was quick to decline to the lower part of the target range, why did monetary conditions not ease even more rapidly between 1992 and 1996?[2]

Our answer focuses on uncertainties and adverse risk perceptions that came to a head in the first half of the 1990s. Rapid growth in government debt and uncertainty about Quebec's role in confederation undermined the confidence of consumers and investors alike. At the same time, large-scale restructuring in the Canadian private and public sectors engendered further uncertainties about employment. In addition, the experience of two decades of inflation created a lingering credibility problem for monetary policy. These problems affected output through a negative impact on household spending, and through people's growing awareness that widespread cuts in government programs or increases in taxes had become unavoidable. Economic activity was further weighed down by the increases in borrowing costs at all maturities caused by the perceived increase in risk.

Several bouts of financial market turbulence were particularly jarring. During these episodes, and in their aftermath, any easing of monetary conditions had to be put on hold, since this turbulence was associated with a perception in the markets that rates ought to be raised. In fact, the evidence from various episodes of this kind suggests that attempts to resist such a tightening can lead to sharp increases in interest rates and to weakness in the Canadian dollar. Tactical choices in the implementation of policy over the past several years have repeatedly been influenced by this danger.

Mindful of the need to build credibility and to not exacerbate the prevailing uncertainty and risk premiums, the Bank of Canada gave a high priority to reducing, or moderating increases in, the risk premium in interest rates through: (1) initiatives designed to reduce the uncertainty about monetary policy actions; and (2) employing cautious tactics – especially during, and in the aftermath of, the periods of turbulence. A lower risk premium would improve the short-term output-inflation trade-off, and eventually allow monetary easing to take place with less likelihood that it would be interpreted, wrongly, as a sign of weakening commitment to inflation control. This approach did not promise or produce quick results. Adverse perceptions had become deeply entrenched, especially in the light of the rapid pace of the growth of government debt at the time.

1 Inflation targets were first introduced in 1991. The target announced in December 1993, for the period until the end of 1998, is to keep the rate of increase of the consumer price index (CPI) within a range of 1 to 3%. The inflation control targets have been announced jointly by the government and the central bank.

2 For a recent discussion of various other aspects of the conduct of monetary policy in Canada, see Freedman (1996).

However, 1996 has seen a marked change for the better. A substantial strengthening in public finances has been effected, and the determination of the Bank to keep inflation within the target range has been made evident. Financial markets have come to focus on the favourable economic fundamentals in Canada as uncertainty regarding fiscal policy has been reduced, and as constitutional wrangling has receded from the headlines. Moreover, the Bank has taken increased care to provide information about the conduct of monetary policy to the public, with the intention of reducing the surprise element in policy actions to a minimum.[3] In the improved environment, the Bank has been able to ease monetary conditions more assertively. Interest rates have fallen significantly below those in the United States – an outcome that many financial commentators had thought unlikely.

Nevertheless, market participants continue to press for more transparency about the conduct of monetary policy, especially with respect to the Bank's views on the transmission mechanism. They seek a firmer basis for assessing an appropriate level for the Monetary Conditions Index (MCI).[4] In response, the Bank is becoming more explicit in its *Monetary Policy Report* about its economic outlook. However, this provides rather limited information about the expected path for monetary conditions, largely because the Bank itself is confronted with considerable uncertainty in this regard. One of the difficulties is the well-known fact that the lags in the effects of its actions on inflation are fairly long and uncertain. While transparency and more open communications have been very helpful in building credibility, the keystone for monetary policy has been the Bank's ability to keep the rate of inflation within the announced target range.

The rest of this paper is organised as follows. Section 1 outlines the broad macroeconomic facts and uses a simple model to describe the background for the conduct of monetary policy in Canada in the first half of the 1990s, focusing on the implications of the increase in risk premiums, low consumer confidence, and the fiscal situation. Section 2 provides statistical evidence from the term structure of interest rates and aggregate demand functions. Section 3 discusses the cautious approach adopted in the conduct of monetary policy. Section 4 outlines current reforms that improve the transparency of the Bank's operating framework.

1 Policy environment

1.1 Broad facts

1.1.1 Monetary policy goals and operating targets

Monetary policy achieved a substantial disinflation. The targets instituted in 1991 for controlling the rate of increase in the consumer price index (CPI) have been met. Indeed, inflation has generally been below the midpoint of the target range. However, despite the persistent excess supply gap, prices blipped upwards in 1995 – the year-over-year increase in the CPI touching 2.9% in May – as the effects of prior exchange rate depreciation and commodity price increases came through.

Activity has been sluggish. GDP has increased at an average rate of less than 2½% since 1991, not even keeping pace with the growth of potential output. The annual increase in final domestic demand has averaged only one percent. Household spending has been held back by uncertain employment income prospects associated with:

- economic restructuring in both private and public sectors;

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3 The Governor of the Bank has put much emphasis on the need for reducing uncertainty in the conduct of monetary policy; see Thiessen (1995).

4 The MCI serves as an operational target. It is constructed by combining the 3-month interest rate and the G-10 effective exchange rate with weights of 1 and 1/3, respectively; see Freedman (1995).

- a gap between real wages and productivity;
- high real interest rates; and
- unsustainable government deficits.

Table 1
Monetary policy goals and operating targets
In percentages

	Inflation			**Output growth**		**Output gap**
	Target range	**CPI**	**Core CPI**	**GDP**	**FDD**	**(GDP)**
1990	n.a.	4.9	3.9	-1.9	-1.9	0.5
1991	n.a.	4.1	2.7	0.0	1.2	-3.1
1992	2 - 4	1.8	1.6	0.5	-0.3	-4.3
1993	$1\frac{2}{3}$ - $3\frac{2}{3}$	1.8	1.8	3.1	2.0	-4.3
1994	$1\frac{1}{3}$ - $3\frac{1}{2}$	0.0	1.6	4.9	2.6	-2.6
1995	1 - 3	2.1	2.2	0.7	-0.1	-2.4
1996	1 - 3	1.5	1.4	1.2	1.4	-3.2

	90-day interest rate		**Real exchange**	**Real**
	nominal	**real**	**rate**	**MCI**
1990	13.0	9.9	0.0	0.0
1991	8.9	6.0	0.3	-3.7
1992	6.7	5.5	-7.2	-6.5
1993	5.0	3.9	-14.5	-10.9
1994	5.7	4.9	-21.2	-12.4
1995	7.2	5.7	-23.1	-12.0
1996	4.8	4.0	-23.1	-14.6

Top panel: Target: December/December change in CPI; 1993 and 1994 interpolated from actual target ending mid-1994. Core CPI: excludes food, energy and indirect taxes. Columns 2-5: 4th quarter to 4th quarter percentage change – except 1996: 2nd quarter to 4th quarter annualised. **Bottom panel:** Real 90-day rate: nominal less lagged 4-quarter change in GDP deflator. Real exchange rate: Canadian dollar against 5 currencies, adjusted with GDP deflators. Real MCI: calculated from preceding 2 real variables. Columns 3 and 4: change from 1990 – except 1996: first 3 quarters.

The problem has not been entirely on the demand side, since productivity growth has also been mediocre. Thiessen (1996b) stresses that this in part reflects the transitional effect of a large, somewhat delayed, economic restructuring in Canada.

There was a considerable easing of monetary condition. The real monetary conditions index (MCI) – a weighted sum of the real short term interest rate and the real value of the G10-weighted exchange rate – fell 5½ percentage points from 1992 to 1995. Since the real interest rate did not show a net decrease, this took the form of currency depreciation, which stimulated activity by contributing to a rapid growth in net exports. Thus, the easing of monetary conditions had its effect on output primarily through the external channel.

Increased risk premiums raised interest rates. Unusually high real interest rates persisted throughout the first half of the decade. Heightened risks – especially with respect to the longer term – were largely responsible for this, as is clear from the depreciation of the exchange rate and also from the steepening of the yield curve over the period. The latter is shown in Section 2 to be a significant factor in the weakness of economic activity.

1.1.2 Government debt growth

Gross government debt, provincial and federal combined, has approached 100% of GDP in recent years, as Canada accumulated budget deficits at a rate well above the G7 countries as a whole (Table 2). The public increasingly came to recognise that the growth in public debt was not sustainable, and that governments would ultimately have to cut their deficits. Furthermore, the longer the adjustment was put off the bigger the cuts would have to be, and the delay in introducing adequate reductions in government deficits exacerbated public anxieties. Expectations of government retrenchment depressed household spending even before the actual large cuts in 1995 began to bite.

Table 2

General government debt and budget balances as percentage of GDP

	Gross debt					Budget balances				
	1990	**1992**	**1994**	**1996P**	**1997P**	**1990**	**1992**	**1994**	**1996P**	**1997P**
Canada...........	73	87	97	99	98	-4.1	-7.4	-5.3	-2.9	-1.8
United States ..	56	62	64	64	64	-2.7	-4.4	-2.3	-1.9	-1.8
Japan	65	64	73	89	95	2.9	1.4	-2.1	-4.8	-3.7
Germany.........	46	46	52	64	66	-2.1	-2.8	-2.5	-4.1	-3.6
France............	40	46	55	60	62	-1.6	-4.0	-5.8	-4.3	-3.7
Italy...............	106	117	124	123	123	-10.9	-9.5	-9.0	-6.7	-6.4
United Kingdom.........	39	48	55	61	62	-1.2	-6.3	-6.8	-4.8	-3.7
Total G7	59	63	68	74	75	-2.1	-3.8	-3.5	-3.4	-3.0

Source: OECD Economic Outlook, June 1996 (P: projected value).

The cuts since then have been major. The total projected decline in the overall budget deficit from 1994 to 1997 amounts to over 4.5% of GDP, which is much larger than the adjustments applied elsewhere in the G7 area. As a result, the government deficit in Canada is currently significantly below the G7 average.

1.1.3 International indebtedness

Growth in external liabilities also accelerated in the early 1990s, as the current account deficit reached almost 4% of GDP (Table 3). This added to the perception that Canada was becoming a riskier place to invest, and there were many stories in the media about the extent to which Canadian governments were "relying on foreign lenders". At a minimum, growing international indebtedness made Canada vulnerable to the backwash of nervousness from disturbances, such as those in the ERM and Mexico, that otherwise did not materially affect its economy (Section 3).

Table 3

International accounts: percentage of GDP

	1990	**1992**	**1994**	**1996P**	**1997P**
Current account	-3.8	-3.7	-3.0	-0.1	1.2
Net foreign liabilities	36.9	42.6	45.2	42.9	40.0

*Source: S*ee Table 2.

In the past couple of years, with the rapid increase in net exports, the current account has improved dramatically. It is expected to be in surplus in 1997. The exchange market has interpreted the swing in the balance of payments as positive news, since it points to a substantial decline in the external debt ratio in the foreseeable future, and revised its expectations for the Canadian dollar accordingly.

1.1.4 Improvement in 1996

Improving fundamentals – substantial declines in budget and external deficits, durable low inflation – have come to the fore this year, as markets have become less concerned about the immediate political situation in Quebec. Published commentary in the press and by private-sector analysts, reflecting this, has undergone a remarkable change and is now very positive. All this has had favourable implications for the exchange rate, and for international interest rate differentials. Short-term interest rates and the MCI have both declined by more than 250 basis points from 1995. Because of the lags in the effects of monetary policy, an acceleration of activity through 1997 is in the cards. Given the excess capacity in the economy, this should not lead to an increase in the underlying rate of inflation.

1.2 A model

Mainstream macroeconomic theory predicts that confidence problems and unsustainable budget positions will result in weakened economic activity and a worsening of the short-run trade-off between output and inflation. The deterioration follows from 4 standard assumptions:[5]

- slowly adjusting output prices, so that output may diverge from its potential level in the short run (Phillips curve);
- instantaneously adjusting asset market prices (open economy asset market equilibrium à la Dornbusch) – the possibility of jumps in the exchange rate implies that the CPI might also move quickly in the short run;
- equality of the domestic interest rate with the foreign interest rate *plus* the expected increase in the price of foreign exchange *plus* a time varying risk premium (perfect capital mobility); and
- aggregate demand responds negatively to the real interest rate and to the real exchange value of the currency (open-economy IS equation).

The real exchange rate moves to maintain equilibrium in the output market in the long run – i.e. to remove any excess supply (demand), the real exchange value of the currency falls (rises). Monetary policy actions can affect the real interest rate in the short run, through the conventional liquidity effect, but not in the long run.[6] Here, some results from the model are outlined, and their relevance to the current situation in Canada is assessed.

1.2.1 Increased risk premium in interest rates

Conceptually, the risk premium problem differs from the credibility problem. A risk premium in interest rates implies that investors *expect* a higher return for bearing extra risk, whereas a credibility problem implies that investors suspect that monetary policy may be looser than the central

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[5] A model with these features is analyzed in Appendix 1. It shares characteristics with R. Dornbusch *Open Economy Macroeconomics*, 1980, Chapter 11. The key difference is that in the present model the central bank targets the inflation rate or price level, and the money stock as such plays no role.

[6] A long-run monetary policy effect is possible to the extent that the central bank's actions influence the risk premium. However, this would usually go in the opposite direction to the conventional liquidity effect.

bank has pledged and hence they *may not expect* the additional return they receive. However, the two are observationally equivalent, since it is not possible to tell from data on returns whether or not the ex post results conform to ex ante expectations.

A shock to confidence (of either kind) does not affect the equilibrium value of the MCI. The interest rate in the long run has to increase by the same amount as the risk premium, and the equilibrium price of foreign exchange has to rise (i.e. currency depreciates) so as to keep the MCI at its original level. In the new equilibrium, the higher interest rate compresses domestic demand, while the currency depreciation creates an exactly offsetting increase in net exports, to maintain output at is potential level. However, during the movement towards the new equilibrium in the model, the increase in consumer prices would temporarily exceed the target, because of the exchange rate feed-through. This means that the short-run output-inflation trade-off necessarily worsens, regardless of the response of the monetary authority.[7]

In short, such a shock has effects that accord with salient facts about the Canadian economy in recent years:

- increased level of domestic interest rates, possibly with overshooting early in the adjustment phase, and hence low domestic demand;
- a depreciation of the currency, causing an expansion of net exports; and
- a worsened short-run trade-off between output and CPI inflation.
- The model also illustrates one reason why the exchange rate is liable to respond in an unstable manner to changes in risk assessments. In numerical terms, on the basis of the Bank of Canada's MCI, in which the weight on the interest rate is 3 times that on the exchange rate, an increase in the risk premium in Canada of 50 basis points would imply a depreciation of the equilibrium value of the Canadian dollar of about 1.5%. However, the margin of uncertainty here is considerable. Estimates at the Bank of the weight of the interest rate relative to that of the exchange rate in IS equations range from 2 to 5. In the example of a 50-basis point increase in the premium, the change in the equilibrium real price of foreign exchange might be anywhere in the range 1 to 2.5%. More generally, uncertainty with respect the long-run value of the exchange rate is several times that with respect to the interest rate, which itself may be sizable. The known economic factors at a given point in time do not provide a firm guide as to where the equilibrium price of foreign exchange should be. This gives a wide field of play for extrapolative behaviour and other such aberrations in exchange markets. Although these are essentially short-run phenomena, they often give rise to questions about the commitment of monetary policy to inflation control, and thereby call for some response from the central bank. Section 3 describes some of the practical consequences of this for policy actions of the Bank of Canada.

1.2.2 Drop in household confidence

Increased reluctance of households to spend on housing and consumer goods reduces the desired level of the MCI (i.e. the equilibrium MCI in the model). In the long run, since the real interest rate is determined by the foreign rate plus a risk premium that does not change under this

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7 Boessenkool et al. (1996) argue that the central bank should not raise the interest rate at all in the event of a drop in the exchange rate prompted by political worries. This argument is not correct. If the risk premium increases, asset-market equilibrium requires that real domestic interest rates must eventually rise by the full amount of the premium. An attempt to hold rates constant would set off a depreciation/inflation spiral. In the case where a political shock of itself pushes down aggregate demand, some easing of monetary conditions would be required. In the short run this might or might not be consistent with an unchanged interest rate, depending on the extent of the decline in the exchange value of the currency.

shock, the easing of monetary conditions must be accomplished entirely through an increase in the price of foreign exchange. In the short run the depreciation of the domestic currency implies a worsened output-inflation trade-off.[8]

- Thus low household confidence would inhibit activity, weaken the currency, and thereby worsen the short-run output-inflation trade-off.

1.2.3 Correction to unsustainable budget position

The relevant exercise here is not a simple matter of comparative statics because it involves an initial situation that was not sustainable.[9] In this situation behaviour would already be affected by an expectation of future government retrenchment, and by uncertainty as to the size, timing and incidence of the measures to be adopted. Nevertheless, as an initial step in the analysis, one can consider the effects of cuts in government spending in an economy which is in equilibrium. This shifts the aggregate demand schedule downward. Maintenance of full employment then requires a monetary easing. Some of this would come about through an induced decline in the risk premium on the country's assets, in response to the stronger fiscal position. On its own, this effect might not be large enough to offset completely the short-run negative effect of the initial cutback, in which case the currency must depreciate.

- Thus, budget retrenchment might produce a *short-run* worsening of the output-inflation trade-off[10] – the emphasis is on *short-run* because, eventually, a stronger fiscal position results in an *improved* trade-off on the path to long-run equilibrium, as the reduction in debt leads to a reduced risk premium, an increase in the real exchange value of the currency and an increased private-sector capital stock.
- However, only a part of the weak macroeconomic performance in 1995 and early 1996 can be plausibly attributed to the tightening of fiscal policy:
  - empirically, a systematic fiscal policy effect on output in Canada is hard to find[11];
  - the lifting of uncertainties engendered by what was widely considered to be an unsustainable fiscal policy in itself had some positive effect on demand. Indeed, the public seems well aware that long-run prospects for future income are improved by the release of productive resources from the state to the private sector;
  - the fiscal cuts encouraged a substantial decline in the Canadian interest rate risk premium, and thereby allowed real monetary conditions to ease through lower borrowing costs, without any decline in the Canadian dollar;
  - the cuts introduced in 1995 will have most impact in 1996 and 1997, yet the consensus outlook shows an acceleration of GDP growth through this period.

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8 The exchange rate might or might not overshoot in response to these shocks. If the central bank resists some of the short-run upward pressure on the price level, the interest rate increases during the transition path. Covered interest parity can then be maintained with a monotonic depreciation of the currency, as sketched in Figures A2 and A3.

9 A point stressed in Thiessen (1996a).

10 This is not a new result. Mundell (1971) showed that the reverse case – a tight-money, easy-fiscal mix – has desirable short-run effects in a country with no risk premium and a floating exchange rate, and his argument was borne out by the early success of such a combination in the US in the early 1980s; see Sachs (1985). This does not imply that the Mundell mix is a desirable policy, since his argument ignores the effects of debt accumulation. Over time increased budget deficits (and hence debt) would raise interest rates, weaken the currency and reduce economic welfare.

11 No economically significant effect was found for fiscal policy variables in the estimated equations for GDP reported later in this paper. The traditional multiplier effect seems to be much weaker than many economists have thought.

2. Estimates of the increase in risk premiums and its effect on activity

2.1 Inferences from the behaviour of the long-term interest rate

As recently as the 1980s empirical tests generally accepted the hypothesis of perfect substitutability between Canadian and US assets.[12] In particular, there was no evidence that changes in relative supplies of government debt exerted any impact on bond spreads. However, the joint hypothesis of rational expectations and a time-invariant risk premium *was* rejected, leaving open the possibility that changes in the risk premium might cause significant variation in the long-term interest rate in Canada independent of that in the United States. More recent econometric research, which benefits from the development of cointegration techniques and from data in which relative debt growth diverges more markedly across countries than in the past, shows that the rapid accumulation of government debt in Canada during the past decade can explain much of the increase in the risk premium that took place.[13]

The risk premium in Canadian interest rates in the 1990s has been affected by political uncertainty as well as by increasing debt. We use the behaviour of the yield curve as a gauge of the overall increase of the premium in long-term rates. Our approach is based on the expectations theory.[14] It assumes that the underlying equilibrium path of the nominal exchange rate follows a random walk, as a result of the multifarious disturbances that may arrive, but that changes in current monetary conditions may lead the actual exchange rate to be above or below long-run equilibrium, and hence create the expectation of a definite change in the exchange rate in the short run.[15] That is, the market has information about monetary policy actions (and possibly other variables too) that in the short run is reflected in the level of the current exchange rate relative to its presumed underlying equilibrium rate. To be more precise, changes in the short-term interest spread are accompanied by immediate changes in the exchange rate as in the Dornbusch model. The exchange rate then is expected to return to its perceived long-run equilibrium level. For Canada this implies that the Bank of Canada may set the short-term interest rate independently in the short run, but that over time the Canadian rate must converge to the US rate plus a time-varying risk premium.

The following equation can be derived from these assumptions (Appendix 2):

$$RL_t - RL_t^* = \gamma\left(R90_t - R90_t^*\right) + \upsilon_t \tag{1}$$

That is, the long-term differential is a function of the cross-country difference in short-term interest rates and the time-varying term-risk premium (the difference between the risk premium on a bond and that on a short-term asset). This may be interpreted as saying that the Bank of Canada has some leverage (γ) on bond yields, through its influence on short-term interest rates. The coefficient γ may be thought of as the length of time that monetary actions in Canada can exert an independent influence on the short-term interest rate, measured as a fraction of the duration of the bond.

In the light of the way budgets, monetary policy and political risks evolve in Canada, over periods of quarters and years, the bond risk premium would be serially correlated. Moreover,

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12 Boothe et al. (1985), Murray and Khemani (1989).

13 See Fillion (1996). Orr et al. (1995), in a multicountry study, find that both fiscal deficits and current account deficits significantly increase domestic real interest rates.

14 It is a quantitative version of an argument used by Goodfriend (1993).

15 In empirical tests of long-term interest rate equations, the assumption that the expected change in the exchange rate is zero has often proved more successful than more complex hypotheses.

since short rates are also affected by risk perceptions, $R90_t$ is not independent of υ_t. In view of these statistical dependencies, we use a VAR to estimate the bivariate relationship between the long- and short-term spreads implied by (1).

ADF tests show that both short and long spreads have followed I(0) processes (Table 4). That is, over time the interest differentials have tended to revert to their long-run average historical value – as would be expected in a world with high capital mobility, similar histories of inflation, and a risk premium on Canadian assets that has varied over time without a definite trend.

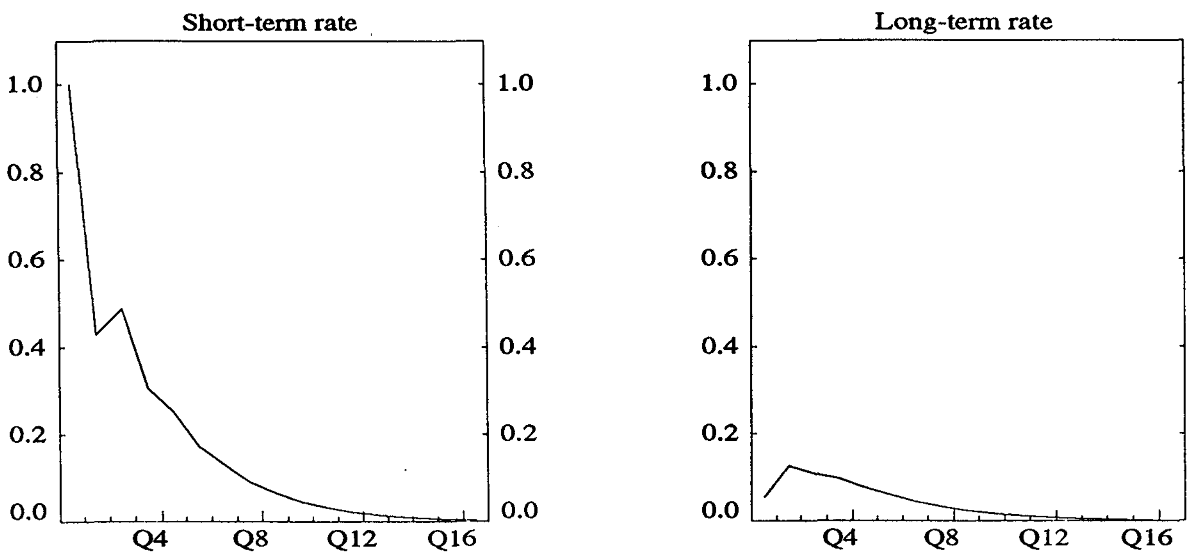
Table 4
VAR equation for the long-term differential

	Coefficient (SE) *t*-1		**Coefficient (SE)** *t*-2	
Constant	0.35	(0.08)		
RL–RL^*	0.77	(0.10)	-0.14	(0.09)
$R90$–$R90^*$	0.08	(0.02)	-0.02	(0.02)
Estimation period	1962 Q4-1990 Q2		SEE 0.28	
ADF test for unit root (probability value) 1962 Q2-1996 Q2				
RL–RL^*	-2.93	(0.042)		
$R90$–$R90^*$	-3.68	(0.004)		

Even though the unit root is rejected, the estimates of the coefficients on the lagged dependent variable in the reduced form imply that movements in the long-term yield differential are quite highly autocorrelated. This is consistent with the spread being dominated by rather persistent movements in the risk premium.

The system impulse-response function for a unit shock to $R90$ shows a peak effect on RL of just 0.13 in the second quarter, after which the effect tapers off quickly (Chart 1). This small effect is close to the "armchair derived" value of 0.10 in Appendix 2.

Chart 1
Impulse response function for a 100 basis point shock to *R90*

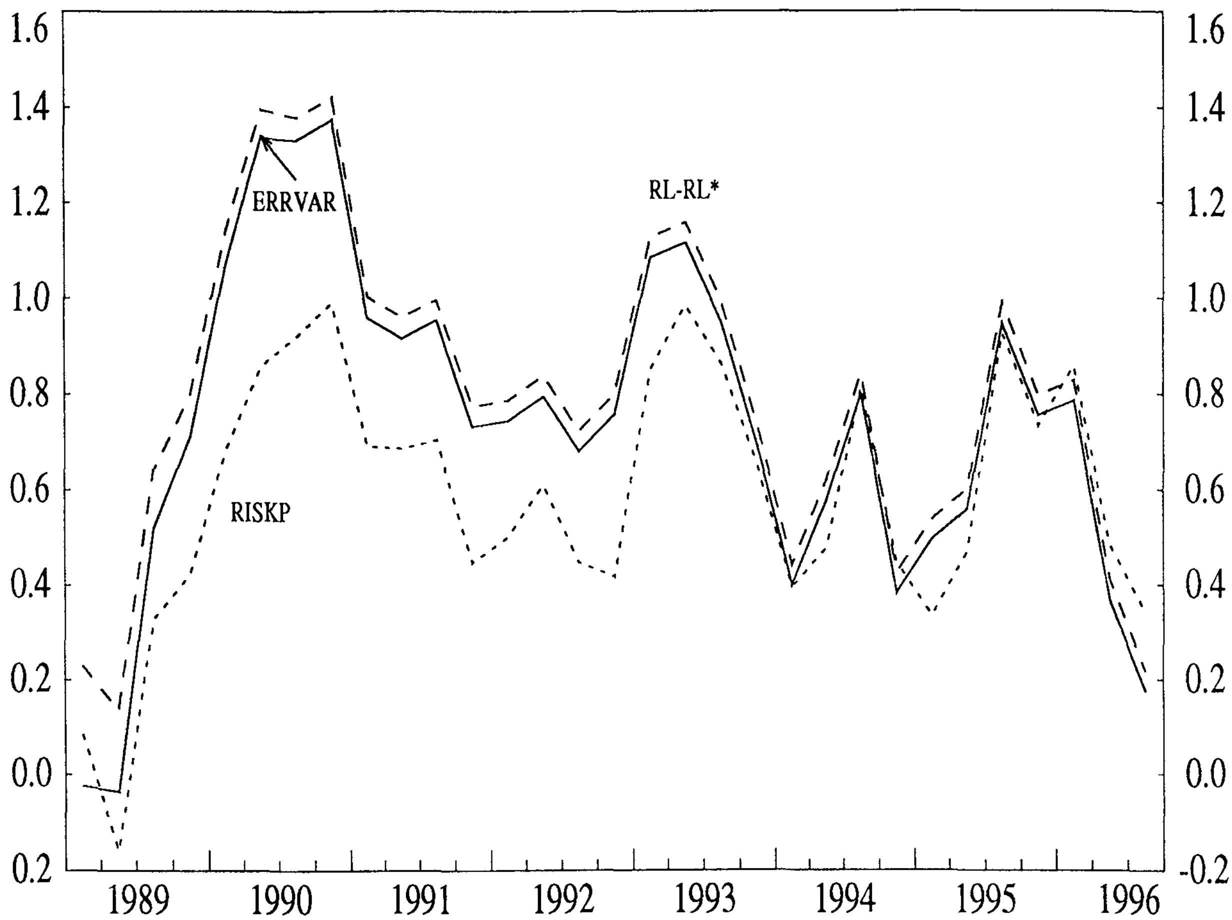


On these grounds, an approximate indicator of the term-risk premium would be given by:

$$RISKP = \left(RL - RL^{*}\right) - 0.10\left(R90 - R90^{*}\right) \tag{2}$$

The second term in this expression takes out the predicted effect of changes in the current short-term spread (which can be attributed to changes in monetary conditions). Chart 2 plots both *RISKP* and *RL-RL** (less the long-run historical values of 97 and 105 basis points respectively), along with the dynamic forecast errors from the VAR (*ERRVAR*).

Chart 2
Canada-US long-term interest rate premium



Each of these lines can be interpreted as estimates of the increases in the long-term risk premium in the 1990s, with the raw spread the least and the VAR error the most sophisticated.[16] ERRVAR is positive throughout, confirming that the structure generating the Canadian bond rate did shift upwards.[17] The VAR simulation is initialised in 1990 Q3, using the actual lagged value of the

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[16] These measures are not necessarily good indicators of the level of the risk premium at a point in time. We use them only to gauge the movement over time.

[17] This finding stands in contrast to other studies. Clinton and Howard (1994) present an equation for the 5-year bond rate that remained stable. However, that study used a shorter-term interest rate, a much shorter estimation period and a less restrictive specification of the expectations theory than the present one. Gerlach (1996), using a very different approach that does not directly incorporate international asset substitutability, finds that the expectations theory with a

spread as a starting point, so it does not, at first, show large errors. However, as the effect of initial conditions fades, the *ERRVAR* converges to the other measures in the chart. The average of all the measures for the period 1990 Q2 - 1995 Q4, centres around 60 basis points, which indicates the extent to which the nominal long-term interest rate in Canada was unusually high. In real terms the increase would be somewhat greater, given the opening of a favourable inflation differential against the United States (of about 1.3% for core inflation over the last 4 years).

Most of the peaks in the chart follow periods of sharply increasing unease with fiscal policy or of setbacks to Canadian political unity. However, the movements in the long-term interest differentials differ significantly from those in the money market differentials discussed in Section 3. The long-term differential has been more affected by low-frequency movements in such variables as the fiscal position and the constitutional conflict, and less by short-lived market disturbances. This might be expected a priori, but it also reflects the firm strategy of the Bank of Canada, which left the markets in no doubt as to the stance of monetary policy, and thereby put them in a better position to look through the short-run volatility.

Since 1995, the chart features a large decline in the long-term premium. This started after the implementation of a credible program of fiscal restraint, by the federal government as well as the majority of provinces, and resumed after the Quebec referendum later that year.

2.2 Estimates of the negative effect of the risk premium from models of changes in GDP

This section uses two models to provide evidence that output has been sensitive to shocks to the risk premium in long term interest rates, and that the increase in the premium caused a reduction in Canadian output growth. The first model is the aggregate demand function developed by Duguay (1994), while the second is based on properties of the yield curve explored by Cozier and Tkacz (1993).

2.2.1 Estimated IS model

The basic model includes the relative price of resource-based commodities, increases in which have a positive effect on Canadian activity, as well as the usual variables in an aggregate demand function. In the augmented model *RISKP* has a sizable negative coefficient.

Table 5
Estimated IS model for quarterly change in GDP

	Basic	**Risk-premium augmented**
US GDP	0.85 (0.07)	0.80 (0.07)
Real *R*90	-0.61 (0.18)	-0.68 (0.18)
Real exchange value of C$	0.11 (0.09)	0.11 (0.09)
Relative commodity price	0.11 (0.05)	0.10 (0.05)
RISKP		-0.38 (0.16)
SEE	0.76	0.74
Estimation period	1962 Q4 - 1995 Q4	

Notes: Variables are differenced, except *RISKP*. Listed coefficients are sums over a distributed lag. No lag for *RISKP*. Standard errors in parentheses.

constant risk premium can be accepted for Canada but not for the United States. It might be difficult to reconcile this with our maintained hypothesis.

2.2.2 *Estimated yield-curve model*

A yield-curve model for GDP can be derived from the idea that the spread between long- and short-term interest rates embodies the gap between expected returns on real investment and the short-term interest rate and the expected rate of inflation. This leads one to expect a positive correlation between the slope of the yield curve and future changes in economic activity. However, to the extent that this spread also contains a time-varying risk premium, this correlation could be weakened or even inverted.

Appendix 2 derives an equation for the term spread that involves three main components:

$$RL_t - R90_t = (1-\gamma)\left[\bar{r}_t - r_t\right] + (1-\gamma)\left[E\overline{\Delta p}_t - \Delta p_t\right] + \upsilon_t \tag{3}$$

where $(1-\gamma)$ is the weight on the long-term components in the determination of the bond yield. The three terms have a straightforward economic interpretation:

- the first is the gap between Wicksell's natural rate and the current real interest rate;
- the second is the expected acceleration in the inflation rate;
- the third is the term-risk premium.

Changes in the first two variables imply changes in incentives to spend; e.g. given the real short-term interest rate, either an increase in the expected real return to investment or an expected acceleration of inflation will cause an increase in spending and the bringing forward of planned future expenses. Monetary policy may have effects through both factors; e.g. an easing will reduce the short-term real interest rate (the liquidity effect) and if anything raise the expected inflation rate.

- If the variance of the term spread is dominated by these two factors, it would be positively correlated with near-term changes in GDP. A wider-than-average term spread would imply rapid GDP growth in the following quarters. The reverse would hold for a negatively sloped yield curve.
- If, on the other hand, the term-risk premium has high variance, any positive correlation between output and the terms in square brackets might be outweighed by the negative correlation between this premium and the desire to spend.

In fact, given the high variance of the short rate, it has been the main component of movements in the spread. Consistent with this, in Canada the historical correlation between the current term spread and the change in output over the next 4 quarters has been strongly positive. Empirical "indicator models" for output exploit this property of the term spread. To gauge the effect of the term-risk premium we have re-estimated these models, as before using the *RISKP* variable as an approximation for it. Ignoring variables not relevant to the present discussion, the form of the estimated equations is:

$$GDP_{t+4} - GDP_t = \xi_0 + \xi_1\left(RL_t - R90_t\right) + \xi_2 RR90_t + \xi_3 RISKP_t \tag{4}$$

where *RR*90 is the real 90-day commercial paper rate.[18] Table 6 contains estimates of variants of (4) estimated for a period ending 1990 Q2.

The basic equation, which ignores the risk premium, is very similar to equations estimated by Cozier and Tkacz (1994). However, after 1990 such equations overestimate GDP growth by a wide margin.

[18] To be more precise, *RR*90 is the 8-quarter lagged moving average of the 90-day commercial paper rate less the 4-quarter change in the GDP deflator.

Table 6
Yield-curve model of 4-quarter-ahead change in GDP

	Basic		Risk-premium augmented	
*RL-R*90	0.89	(0.14)	0.91	(0.13)
RISKP	–		-1.05	(0.40)
*RR*90	-0.28	(0.06)	-0.26	(0.05)
SEE	1.64		1.59	
Estimation period	1962 Q4 - 1996 Q2			

Note: Estimated by Hodrick-Hansen GLS procedure, allowing for 4-quarter moving average in the error.

Part of the explanation for the bias appears to be the increased risk premium. The second equation extends the estimation period through 1996 Q2 and brings in *RISKP* – and again its coefficient is significant and sizable.

2.2.3 Inferring the impact on activity

The implied effect of the post-1990 increase in the risk premium on output growth can be obtained from model simulations in which the *RISKP* is held to its average pre-1990 value of 0.97. Results are shown in Table 7.

Table 7
Effect of increased long-term interest risk premium on GDP growth: estimates from model simulations

	IS model	Yield-curve model
1991	-0.95	-1.03
1992	-0.74	-0.47
1993	-1.26	-0.43
1994	-0.80	-0.68
1995	-0.93	-0.47
Sum	-4.68	-3.08

Note: 4th quarter to 4th quarter percentage change – simulated minus actual.

The cumulative impact suggests that the persistence of heightened risks had a serious medium-term effect on the economy. Indeed, by 1995 the estimated cumulative output loss arising from the increased risk premium is of the same order of magnitude as the output gap.

3. How confidence problems affected the conduct of monetary policy

3.1 Tactical considerations

The Bank of Canada, through its operations in financial markets maintains the overnight interest rate within a band that it varies as necessary to achieve a desired path for monetary conditions. Freedman (1995) notes that there are "tactical" elements in the process, since the Bank has to take into account the situation in financial markets. In the first half of the 1990s this was a consideration, particularly in periods in which the Bank wanted to initiate an easing in monetary conditions. Its tactics throughout were designed to reinforce the credibility of monetary policy, which was not yet established, and to reduce risk premiums.

Given the heightened uncertainties, the strategic easing of monetary conditions often had to give way to the tactical necessity of promoting orderly markets.[19] Although the Bank could not prevent risk premiums from rising through this period, given the fiscal and political situation, promoting orderly markets was viewed as a helpful way of containing risk premiums, while ensuring that the desired easing could eventually be achieved.

Pursuing unconstrained easing might have been interpreted by the market as a relaxation in the Bank's resolve to keep the rate of inflation from moving above the inflation control target range, which in turn could have triggered even higher risk premiums, and prevented the desired easing in monetary conditions from taking place.[20]

During these recurring episodes of heightened uncertainty, monetary conditions tended to tighten relative to the desired path in response to a sharp increase in short-term Canadian interest rates – reflecting a change in investors' willingness to hold Canadian dollar denominated assets – which was only partially offset by a weaker exchange rate. The Bank's operations helped financial markets find viable trading ranges for interest rates and the exchange rate.

It may be tactically propitious to postpone achieving a given desired path for the MCI in the short run if markets are unsettled. This does not mean that the Bank has to wait entirely on the market. In periods when the Bank and the market disagree over the appropriate course for monetary policy, it is incumbent on the Bank to try to develop an appreciation in the market of the economic fundamentals it thinks are relevant. By communicating the economic rationale underlying its policy stance (and by being clear about the way in which policy is being implemented), the Bank can minimise the uncertainty about its policy intentions, and ensure that it does not add to the risk premiums already present in Canadian interest rates.

3.1.1 Winter 1994-95: an example of heightened market volatility

The winter 1994-95 episode of market volatility offers an example of what can happen when the Bank attempts to achieve easier monetary conditions than the market views as appropriate; Charts 3 to 7 provide a graphical summary of events through this period. Turbulence in financial markets emerged in response to:

Positive output surprise

- growing expectations in the market that the stance of monetary policy in Canada and the United States would have to be tightened in the near future;
- the release of data suggesting that the US and Canadian economies were expanding at a rapid pace in the fourth quarter led some economists, who relied on models that emphasised the rate of growth in output as an indicator of future inflation, to predict that the core rate of inflation would rise. This view was not shared by the Bank because its model emphasises instead the size of the output gap, which remained wide; and

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[19] See Zelmer (1996) for a discussion of several of such episodes.

[20] Actions to tighten the stance of monetary policy might not have been subject to an analogous constraint. Such actions, even if not expected by market participants, are not likely to cause them to wonder whether the Bank's policy goal has changed. Instead, they are more likely to assume that the Bank is better informed about the state of the economy and that inflationary pressures are more intense than they had previously thought. As a result, they would likely respond quickly to ratify the Bank's desire for tighter monetary conditions with higher interest rates and possibly a firmer exchange rate.

- by late December the Bank had reassessed its economic outlook and concluded that, as a result of the narrowing in the output gap, it should accept the tightening that had developed in the market. However, it was reluctant to raise the overnight rate again to ratify the further increase taking place in short-term interest rates because it was concerned that such an action might trigger even higher rates.

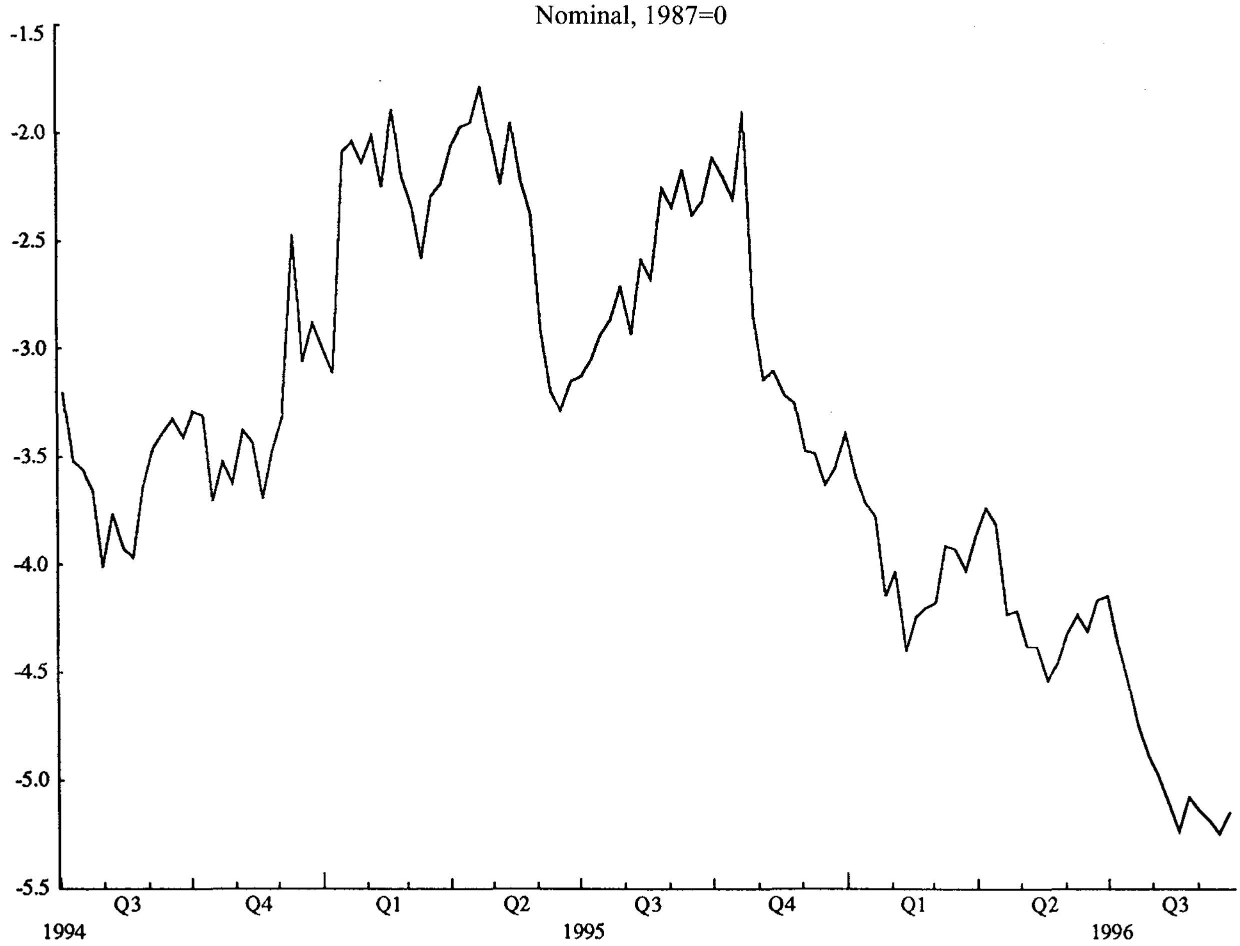
Risk assessment shift

- the Mexican financial crisis focused investor attention on countries experiencing large fiscal and current account imbalances; and
- the Bank's initial resistance to the increase in short-term interest rates led to concern over the credibility of the monetary policy stance.

Negative spreads between Canadian and US short-term interest rates

- many commentators did not believe that the negative interest rate spreads achieved in the fall of 1994 were sustainable, given Canada's debt problems.

Chart 3
Monetary conditions index
Nominal, 1987=0



Market pressures – evident in the rise of 1- and 3-month interest rates – obliged the Bank to raise the band on several occasions, to avoid the risk of a loss of confidence in foreign exchange and bond markets. Given the sizeable increase in short-term interest rates that had taken place in December and early January, the financial markets clearly expected a steep rise in the overnight interest rate, and the Bank's initial hesitancy to raise the operating band may have contributed to their uncertainty. It appeared to engender a perception that the Bank was more willing to tolerate exchange

Chart 4
Overnight rate versus the 3-month T-bill rate

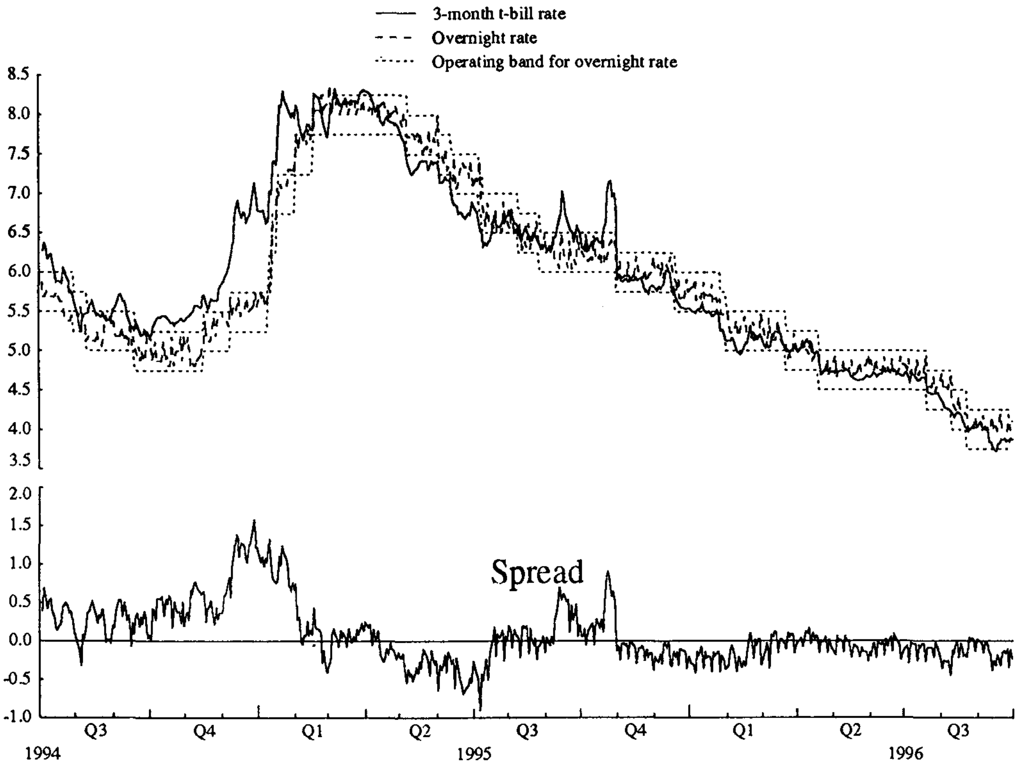


Chart 5
3-month interest rates

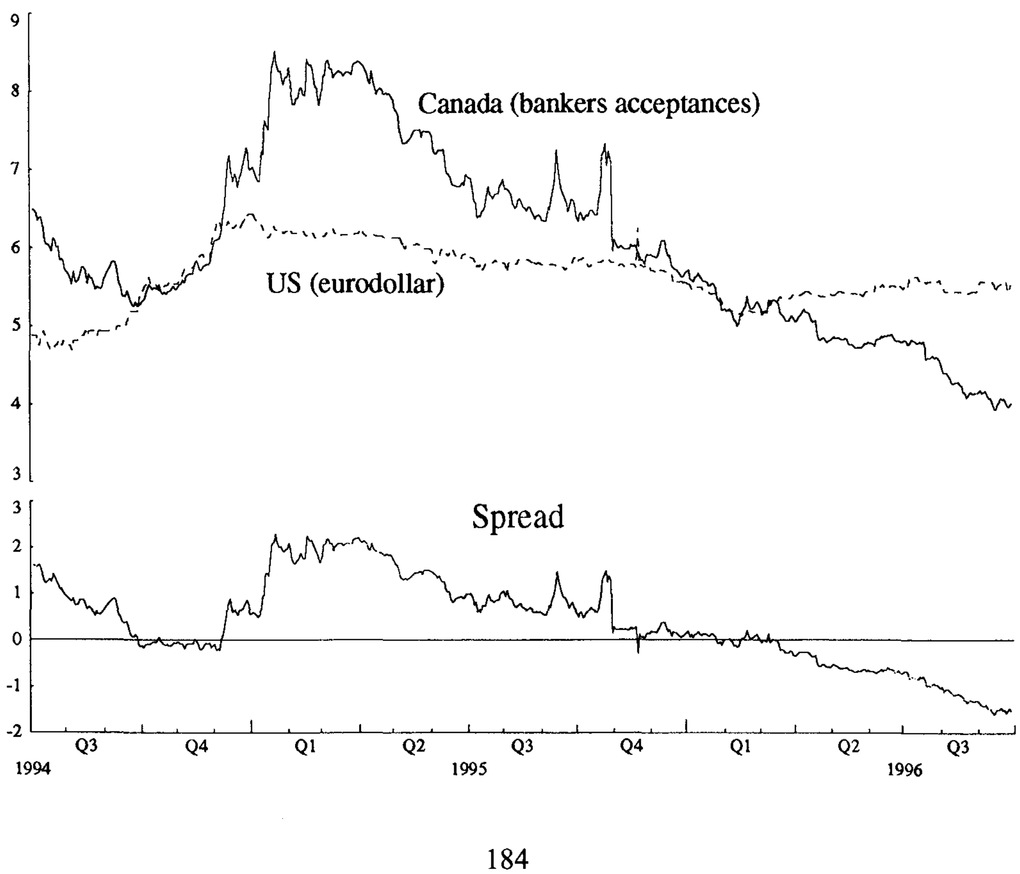


Chart 6
Long-term bond yields

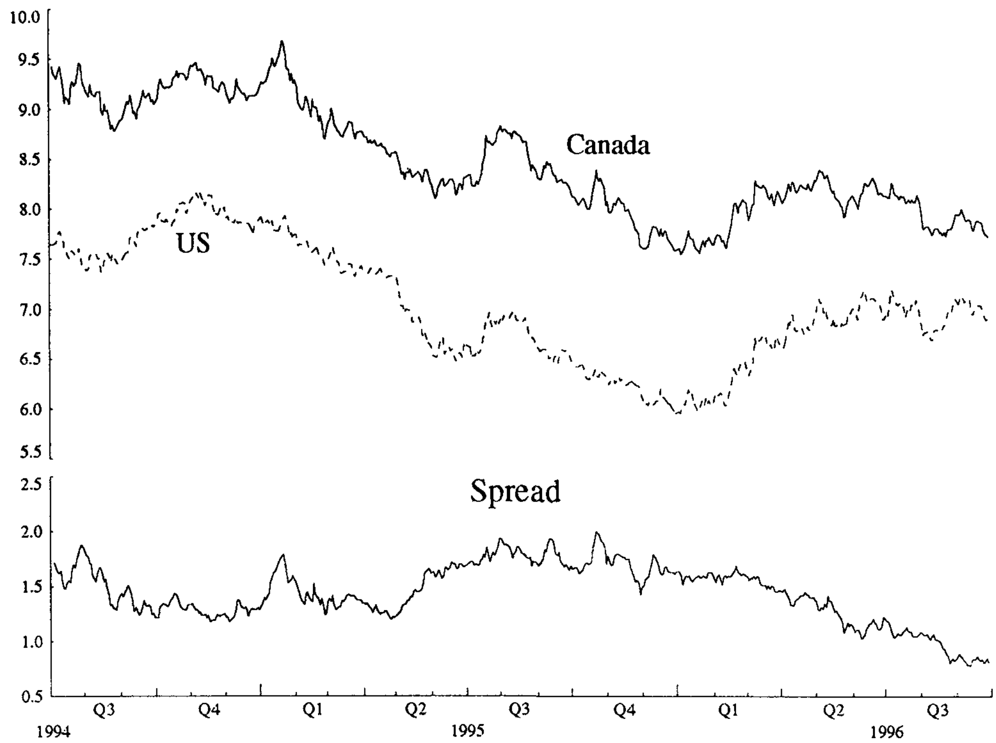
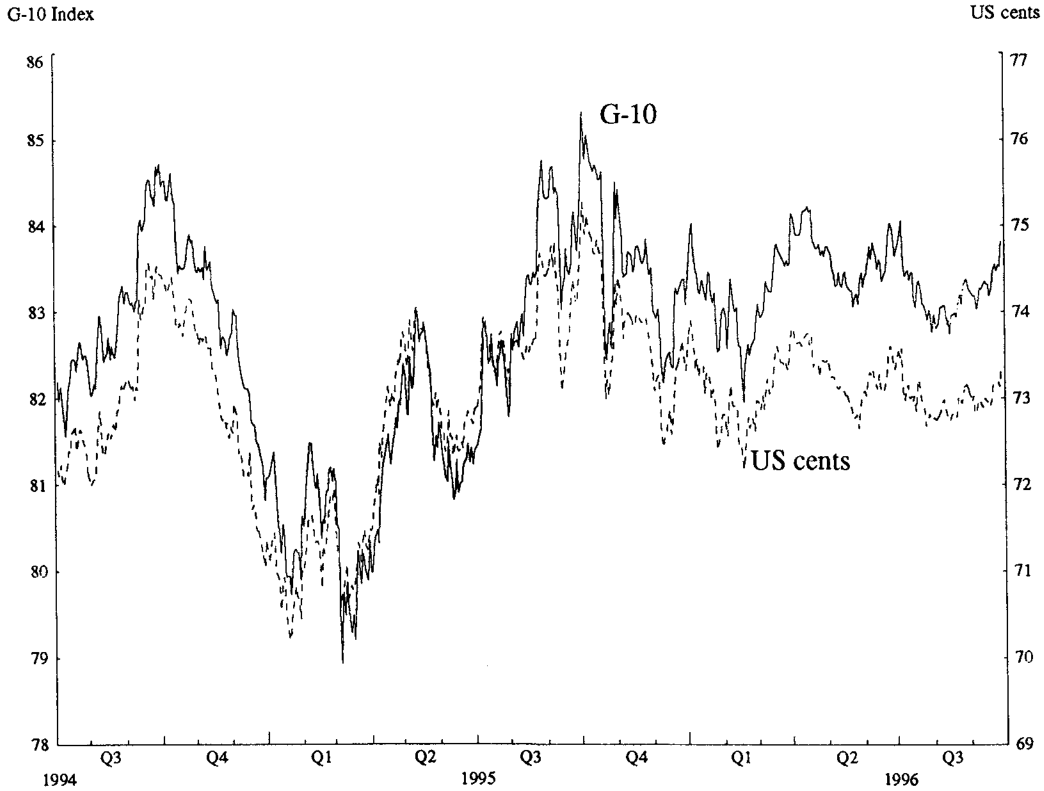


Chart 7
The Canadian dollar



rate depreciation than in the past. There was also the prospect of a worsening fiscal balance in the wake of the higher interest rates. As a result, fears mounted that the as yet unproved government would be tempted to take risks on the side of inflation rather than take tough fiscal measures. Investors shifted their funds away from Canada, thereby causing interest rates in Canada to move even higher and the value of the Canadian dollar to decline even further.

The widening of the spread between Canadian and US interest rates was largely confined to the short end of the term structure – the spread between long-term bond yields did not begin to widen significantly until early January – implying that market participants did not expect the increase in Canadian interest rates to persist for an extended period of time. When the turbulence did begin to spill over into the bond market, the Bank moved quickly to calm markets by further increasing the operating band for the overnight interest rate. And the disturbance in the bond market was short-lived.

The market's questioning of the Bank's policy stance raises a couple of questions: did the market fail to understand the economic rationale behind the Bank's initial stance in December, or did it simply take a different position on the economic outlook from the Bank? If the answer to the first question is yes, the policy stance would have been credible (and market volatility reduced) if the market had possessed more information on the economic rationale underlying the stance. On the other hand, a positive response to the second question implies that the market understood the Bank's actions but disagreed with its view of the economy, and feared that the risk of inflation/exchange rate depreciation was greater than perceived by the Bank. If so, this suggests that although the activities of the Bank were transparent to financial markets, the Bank lacked the credibility to prevent, in the short run, an undue tightening in monetary conditions. Either way, it suggests that the Bank needs to ensure that market participants understand its views on the economy and on the outlook for inflation that underlie a particular policy stance, and that its actions are predictable. This is similar to the argument of Goodfriend (1986) that increased transparency of monetary policy would benefit society because (1) the amount of guess-work involved in market responses to policy action falls, thereby making the market's responses to policy actions more predictable and improving the information content of financial market prices, and (2) some resources previously wasted, from a social point of view, on monitoring central bank activities are turned to productive uses.

3.2 Has the focus on the MCI caused some confusion?

Some participants argue that the market has considerable difficulty determining the appropriate path for the MCI, especially as the lags in its effect on inflation must be fairly long, and the market does not receive much practical guidance from the Bank.[21] Moreover, they believe that the Bank's resistance to rapid exchange rate movements has led the market to the (incorrect) conclusion that the Bank's MCI target has been quite rigid in recent years. As a result, market participants may not have tried hard enough to identify whether desired monetary conditions may have changed. On observing a change in the value of the Canadian dollar, they might speculate that the Bank will eventually adjust interest rates in order to keep monetary conditions broadly unchanged. If this argument is correct, it implies a persistent negative relationship between changes in interest rates and the value of the Canadian dollar, even in periods where market conditions are tranquil.

Zelmer (1996), in contrast, suggests that the negative relationship described above is only significant in periods when there are weakly-grounded (and hence varying) views regarding Canada's fiscal and political situation.[22] In essence, variations in the market's perceived risk premium for

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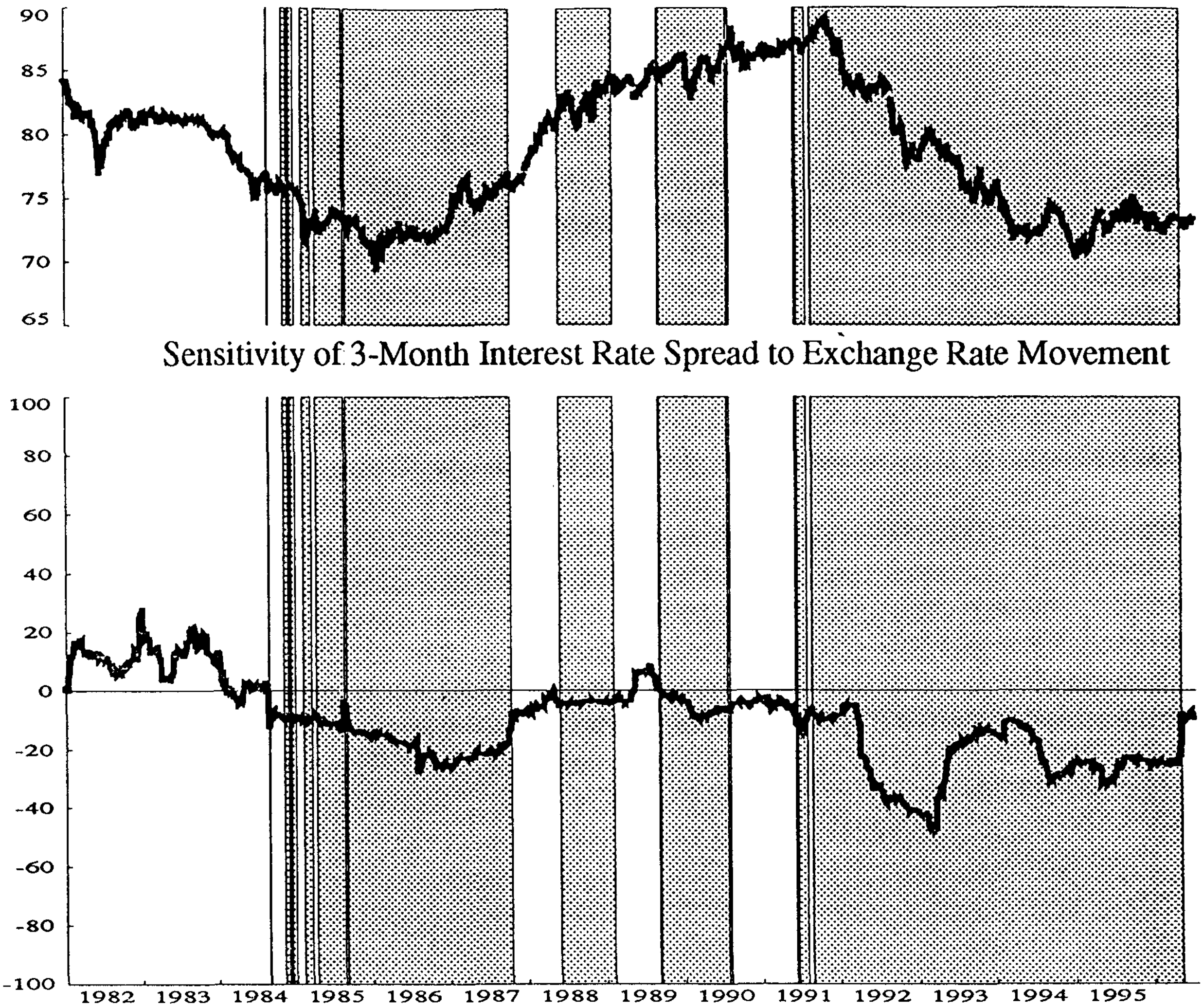
21 See, for example, the comments by Neufeld on Zelmer (1996).

22 An alternative (and observationally equivalent) interpretation is that in the event of portfolio disturbances in exchange markets the Bank was asymmetrically sensitive to Canadian dollar depreciations. In an environment such as the early 1990s in which expectations regarding monetary policy were not completely anchored and government and external indebtedness were growing rapidly, it would be tactically appropriate to defend the currency against rapid

Canada can be viewed as portfolio shocks that cause Canadian interest rates and the value of the Canadian dollar to move in opposite directions, but which should not affect the desired longer-term path of monetary conditions. Thus, changes in short-term interest rates have frequently been required to offset the macroeconomic impact of changes in the exchange rate. The market appears to have recognised this point (which may have been reinforced by the Bank's focus on the MCI as its operational guide to policy) and has tried to anticipate the Bank's policy response in periods where these shocks are present.

The main empirical distinction between these two hypotheses is: whether or not an inverse relationship between changes in short-term interest rates and in the value of the Canadian dollar is present on a regular basis. If this behaviour is confined to periods associated with readily identifiable portfolio shocks, this would suggest that the Bank's operational focus on the MCI does not systematically hinder policy implementation.

Chart 8
The Canadian dollar
In US cents



Coefficient values from rolling 12-month regressions

Note: Shaded areas represent statistically significant negative coefficients.

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depreciation. Such an approach would help to contain risk premiums and help build credibility for monetary policy, thereby facilitating a more durable easing when circumstances become more propitious.

To obtain evidence on these hypotheses one can posit a simple relationship between daily movements in the Canada-US short-term interest rate spread and changes in the value of the Canadian dollar (in US cents):[23]

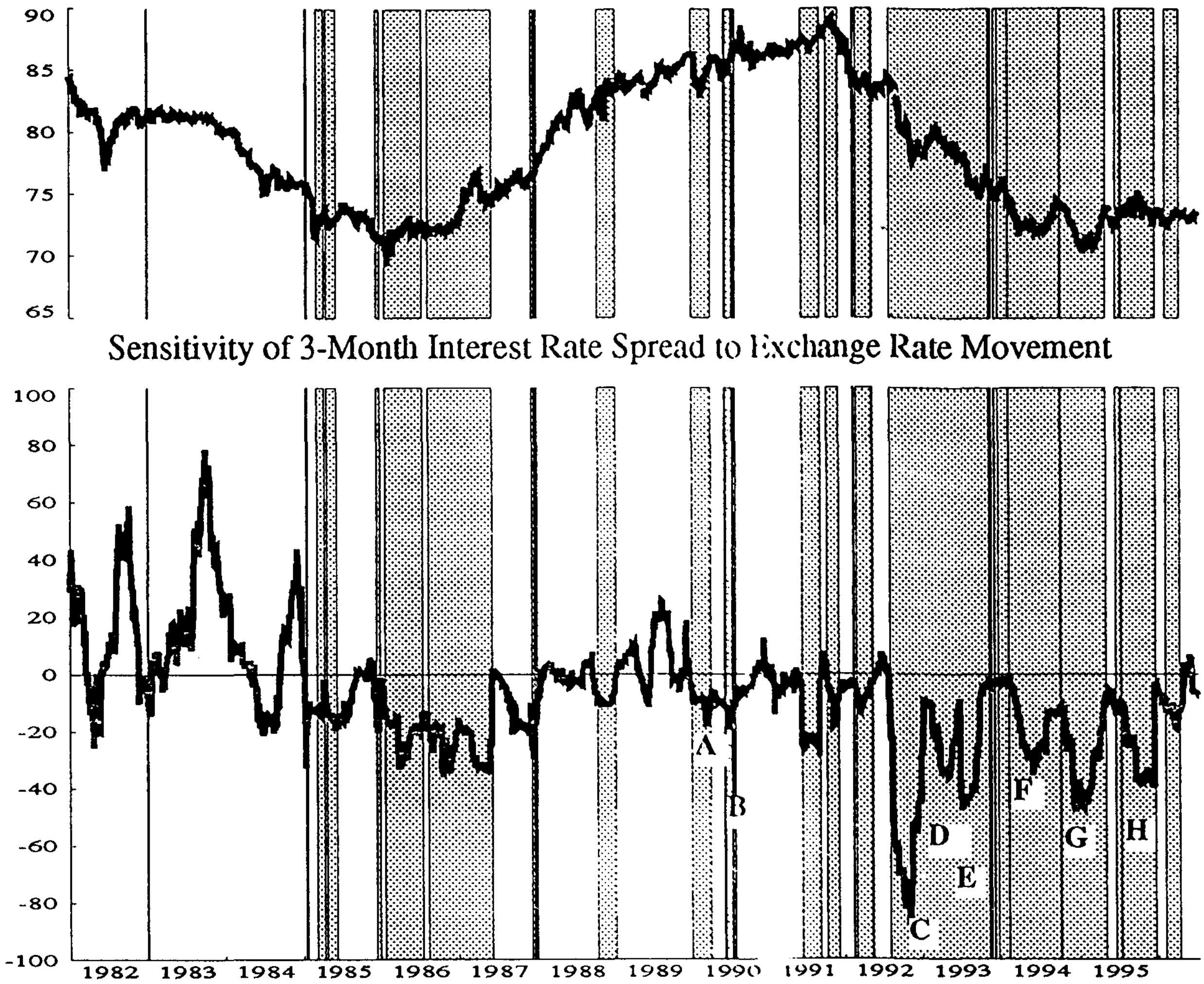
$$\Delta Spread_t = \beta_0 + \beta_1 \Delta \log XR_t + \beta_2 \Delta \log XR_{t-1} + \varepsilon_t \qquad (5)$$

To estimate this relationship empirically, the daily change in the 3-month bankers' acceptance – US eurodollar interest rate spread was regressed on daily percentage changes in the value of the Canadian dollar.[24] One lag of the daily percentage change in the exchange rate was included in

Chart 9

The Canadian dollar

In US cents



Coefficient values from rolling 3-month regressions

Note: Shaded areas represent statistically significant negative coefficients.

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[23] The interest rate spread is used instead of the level of the Canadian rate in order to focus on changes specific to Canada's risk premium, as opposed to common international changes.

[24] The bankers' acceptance – US eurodollar spread is used here because it is applied by market practitioners to price currency and foreign exchange swaps. Moreover, short-term interest rate futures contracts are priced with reference to these interest rate series. As a result, this interest rate spread tends to be more sensitive to exchange rate developments than differentials on either commercial paper or treasury bills.

the analysis because it was significantly correlated with changes in the current interest rate spread in some periods.

Regressions were run on a rolling 3- and 12-month basis; the sum of the exchange rate coefficients from each regression are plotted in Charts 8 and 9.[25] Shaded areas represent those periods where the rolling regressions generated statistically significant negative coefficients. Admittedly, the estimated coefficients are biased, since both the interest rate and the exchange rate may respond to common shocks. However, for the purposes of this analysis, the main point of interest is the time pattern of the coefficients not their values per se.

The plot of the coefficients from the rolling-12-month regressions (Chart 8) offers some support to the view that the short-term interest rate spread became more sensitive to exchange market developments in the 1990s. It is not surprising that some market participants noticed this trend from market data even before 1994, when the Bank published articles clarifying its use of the MCI in the conduct of monetary policy.[26]

However, the pattern of changes in the coefficients in the rolling-3-month regressions (Chart 9) suggests that the episodes of negative relationships observed in the 1990s have occurred mainly in response to changing perceptions regarding the appropriate risk premium for Canada. Indeed, the timing of the largest negative spikes are broadly consistent with episodes of rapid exchange rate depreciation that were motivated, at least in part, by bouts of pronounced uncertainty regarding the fiscal situation in Canada, unresolved constitutional conflicts, the credibility of monetary policy, and the spillover of international market turbulence arising from the ERM and Mexican crises (see Table 8). As the turbulence abated, the exchange rate coefficients tended to move back towards zero. Indeed, as noted earlier we have witnessed a significant improvement in the policy environment this year. The negative relationship between changing interest rate spreads and exchange rate movements has evaporated and the Bank has been able to take more direct action in financial markets to achieve the desired easing in monetary conditions.

Table 8

Summary of disturbances in market confidence

Event	Date	Description of event
A	Early 1990	Unsuccessful attempt to ease monetary conditions.
B	Mid-1990	Collapse of the Meech Lake constitutional accord.
C	Autumn 1992	Concerns over fiscal policy deepens following Standard & Poors' downgrade of Canada's foreign currency debt from AAA to AA+. ERM turbulence. Defeat of Charlottetown referendum on constitution.
D	Spring 1993	Market's concern regarding fiscal policy deepens after federal budget.
E	Summer 1993	Political uncertainty ahead of federal election. ERM turbulence.
F	Spring 1994	Further market disappointment with federal budget.
G	Winter 1994-95	Spillover of Mexican crisis. Fiscal situation attracts international attention – "Bankrupt Canada?" headline in *Wall Street Journal*. Market concern over credibility of monetary policy stance. Federal budget enacted that market felt dealt forcibly with the fiscal situation.
H	Autumn 1995	Quebec referendum.

25 The coefficient values are plotted at the mid-point of the regression period; e.g. the sum of the exchange rate coefficients for a regression run over the 1st January 1996 - 31st March 1996 period would be plotted at 15th February 1996.

26 See Freedman (1995).

3.3 1995-96: Improving policy environment

Charts 3 to 7 also summarise conditions in financial markets since the Bank began lowering the operating band for the overnight interest rate in the spring of 1995. Ignoring turbulence preceding the Quebec referendum in October, this period witnessed a steady and significant easing in monetary conditions. Interest rates fell sharply, with spreads against US rates declining across the term structure. The value of the Canadian dollar was stable. Indeed, short-term interest rates in Canada moved below those in the United States in early 1996. [27]

From November 1995, successive *Monetary Policy Reports* had suggested explicitly that monetary conditions might have to ease in order to keep inflation near the mid-point of the inflation control target range. Also, the Bank mentioned the need for easier monetary conditions in press releases accompanying the reductions in the operating band for the overnight interest rate.

Some benefits of giving the market more information on the Bank's desired policy stance were demonstrated in this period. The *Monetary Policy Report* of May 1995 advised that the uptake in inflation would be soon reversed. This helped to ensure that expectations did not become unhinged as the rate of inflation approached the top of the control range, and kept uncertainty about how the Bank would respond to a minimum. The fact that Bank's projection proved correct contributed to the market's subsequent willingness to accept easier monetary conditions.

4. Recent and prospective changes to operating procedures

The Bank has taken various initiatives in the 1990s to provide a firmer grounding for expectations regarding inflation and to ensure that it's actions in markets were clear. These included:

- introducing explicit inflation-control targets, together with the federal government (1991);
- adopting the operating band for the overnight interest rate, which is the interest rate over which the Bank has the most influence (1994) – and adopting the practice of issuing a press release when there is a change in the band (early 1996);
- publishing the MCI and attempting to clarify how the Bank uses it (1994);
- introducing the semi-annual *Monetary Policy Report* to provide external observers with more information regarding the Bank's outlook for monetary conditions (1995);
- more openness in speeches and Bank publications, and a 1995 conference on money markets and monetary policy operations.

The Bank has also taken advantage of structural changes in markets in recent years to make its operating framework more transparent (see Table 9 for a chronology). This helps provide a firmer grounding for expectations, and is also useful for accountability after the event.

To adapt to the forthcoming introduction of the Large Value Transfer System (LVTS), the Bank will make changes to its operating procedures which will further increase the transparency of its operation – to such an extent that there will probably be no need for frequent open market intervention to establish the limits of the overnight rate operating band.[28] The rather opaque "drawdown and redeposit" mechanism, using government deposits to adjust the balance of liquidity in the system, will come to an end. Announced central bank deposit and lending rates for settlement

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[27] Prior to this year market participants were emphatic in their belief that Canadian interest rates could not move below those in the United States for an extended period. See, for example, comments by Gignac and others in Bank of Canada (1996b).

[28] Bank of Canada (1996a).

balances will enforce the band.[29] In addition, the Bank has plans to signal a desired overnight interest rate within the band using SPRA or SRA transactions, as appropriate. If that proves useful, one purpose of this would be to provide the Bank with an instrument with which it can indicate to the market any changes in the way it views the outlook for possible future interest rate movements without taking formal action to change the band.

Table 9
Evolution of Bank of Canada operating procedures

Date	**Description of event**
March 1980 - February 1996	Bank rate set at 3-month Treasury bill rate + 25 basis points.
November 1991 - June 1992	Operating procedures change in anticipation of the removal of statutory reserve requirements.
June 1992 - June 1994	Statutory reserve requirements phased out.
Middle of 1994	Introduction of a 50 basis point operating band for the overnight rate.
February 1996	Bank rate set at upper limit of the operating band.
1997	Planned introduction of LVTS: • Introduction of central bank deposit and lending rates. • Announcement of daily target for overnight rate within band.

[29] The profile of the drawdown and redeposit mechanism has already receded since the introduction of the operating band for the overnight interest rate, which is implemented using highly visible buy-back operations (SPRA/SRA). However, this mechanism is still used for the crucial job of controlling the supply of settlement balances.

Appendices

1. Implications of shocks to the risk premium and confidence and of budget retrenchment

Notation

cpi	consumer price index
cpi^T	central bank target for cpi
e	price of foreign exchange
E	expectations operator
i, (i *)	one-period domestic (foreign) interest rate
mci	real monetary conditions index
p	price of domestic output
r, (r*)	domestic (foreign) real interest rate: $i_t - E\Delta p_{t+1}, \left(i_t^* - E\Delta p_{t+1}^*\right)$
RL, (RL*)	domestic (US) over-10-year bond yield average
R90, (R90*)	domestic (US) 3-month commercial paper rate
x	real exchange rate: $e_t - p_t + p_t^*$
$y, \bar{y}$	actual and potential output
$\bar{e}, \bar{x}, etc.$	expected long-run equilibrium values
u	term-risk premium
υ	country risk premium
All variables in logarithms except interest rates.	

A simple theoretical model is used here to show how the short-run trade-off between output and inflation would deteriorate in consequence of problems with confidence and with the fiscal position. The approach to monetary policy is in the spirit of Duguay (1994). *However, this model is not stochastic, and so the monetary policy target applies equivalently to the price level or to the rate of inflation.*[30] Thus, the central bank is assumed to set monetary conditions to achieve a path for the CPI that is defined to embody a constant inflation target, *INFLT*.

The public is assumed to believe with 100% confidence that the target path will be achieved. This, together with the absence of stochastic drift, makes it easy to pin down the equilibrium values of the nominal variables in the model. However, following changes to exogenous variables, in the short run the price level may diverge from the target path, because monetary policy operates with a lag.

Model equations

Monetary policy target and expected path of price level:

$$cpi_t^T = cpi_0 + tINFLT \tag{A1}$$

[30] In practice the Bank of Canada has an inflation target rather than a target for the trend of the price level. For the purposes of the present discussion this does not matter.

This defines a path for the target for the price level as the integral of the target rate of inflation, *INFLT*. The public believes with 100% confidence that any deviations from the target path will be strictly temporary.

The CPI is a weighted average of domestic and foreign output prices:

$$cpi_t = \alpha p_t + (1-\alpha)(e_t + p_t^*) = p_t + (1-\alpha)x_t \tag{A2}$$

In the long run *cpi* and *p* change at the rate *INFLT*, and x_t is constant. However, since changes in exogenous variables may move the real exchange rate, in the short run all variables may deviate from the equilibrium path. The central bank approaches the CPI target via a partial adjustment process:

$$\Delta cpi_t = \beta(cpi_t^T - cpi_{t-1}) \tag{A3}$$

The extent to which monetary policy allows deviations of the price level from target is embodied in the parameter β. For example, if following a shock the central bank aims to get back on target within 8 quarters, β would be approximately 0.3 in a quarterly model.[31]

Expectations-augmented Phillips curve:

$$\Delta p_t = \pi(y_t - \bar{y}_t) + INFLT \tag{A4}$$

In this specification domestic output prices (and implicitly wages) are set on the basis of the expected underlying rate of inflation, not the expected short-run rate of inflation.

Aggregate demand function:

$$y_t = \mu_t + \delta x_t - \sigma r_t \tag{A5}$$

where μ represents the effects of exogenous variables such as foreign demand, fiscal policy and consumer confidence. In equilibrium, A2-A5 jointly determine the 2 short-run rates of inflation, the level of output and *real* monetary conditions. A5 implicitly defines the equilibrium (or desired, from the viewpoint of the central bank) real MCI; i.e. the set of combinations of the real exchange rate and the real interest rate that result in the targeted inflation rate.

The equilibrium level of the real exchange rate and the real interest rate can then be obtained given the asset market equilibrium condition:

$$r_t = r_t^* + E\Delta x_{t+1} + \upsilon_t \tag{A6}$$

i.e., the domestic interest rate is equal to the foreign rate plus the expected change in the price of foreign exchange plus a time-varying risk premium. In equilibrium, the real exchange rate is constant, so that this condition gives the horizontal line $r_t = r_t^* + \upsilon_t$. However, in the short run the exchange rate might not be at its equilibrium level, in which case it will be expected to move towards it.

The following process is assumed for exchange rate expectations:

$$E\Delta x_{t+1} = \theta(\bar{x}_t - x_t) \tag{7}$$

i.e., the exchange rate is expected to move in steps from the current to the equilibrium level.[32] This yields the short-run asset market equilibrium condition:

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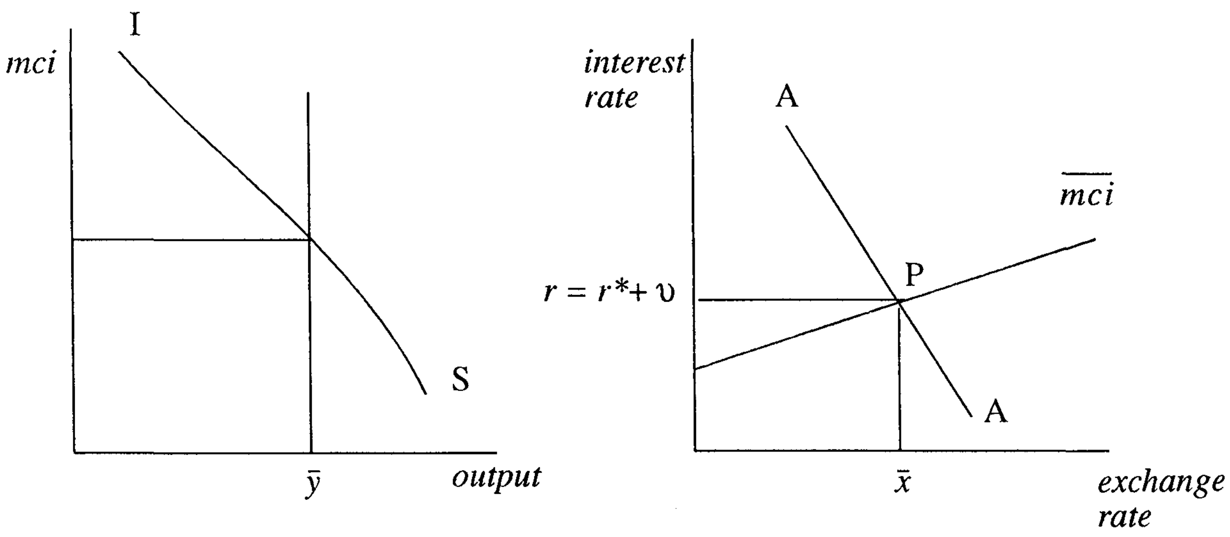
[31] These approximations are based on the formula, $p = 1-(1-\beta)^n$, where *p* is the proportion of the gap that is closed after *n* periods. The value for β of 0.3 would close more than 90% of any gap within 2 years.

$$r_t = r_t^* + \theta\left(\bar{x}_t - x_t\right) + \upsilon_t \tag{8}$$

Model equilibrium

The intersection of the IS curve in Figure A1 with potential output gives the equilibrium or desired level of monetary conditions, $\overline{mci}$. The combinations of real exchange rates and interest rates that yield $\overline{mci}$ is shown as a line, the slope of which is δ/σ.[33]

Figure A1



Asset market equilibrium determines the feasible combinations for the interest rate and exchange rate. Equation A8 describes a downward sloping line with slope $-\theta$ (AA in the figure). Since asset prices adjust immediately, the economy will always be on this line. The intersection of AA with $\overline{mci}$ is the point of joint equilibrium in asset and goods markets. The intersection of AA with the line at P is the unique point at which the assets and goods markets are in equilibrium.[34]

Risk premium/credibility shock

Either shock can be represented by an increase in the risk premium υ_t, $d\upsilon$:

$$r_t = r_t^* + E\Delta x_t + \upsilon_t + d\upsilon$$

In Figure A2 this is depicted by shifting the long-run horizontal asset market equilibrium line upward by $d\upsilon$, to $r = r^* + \upsilon + d\upsilon$. The short-run asset market equilibrium line AA shifts to the right to intersect the new long-run equilibrium point Q (this shift would be immediate in the case of rational expectations). In turn, Q must be on the $\overline{mci}$-line since the equilibrium level of monetary

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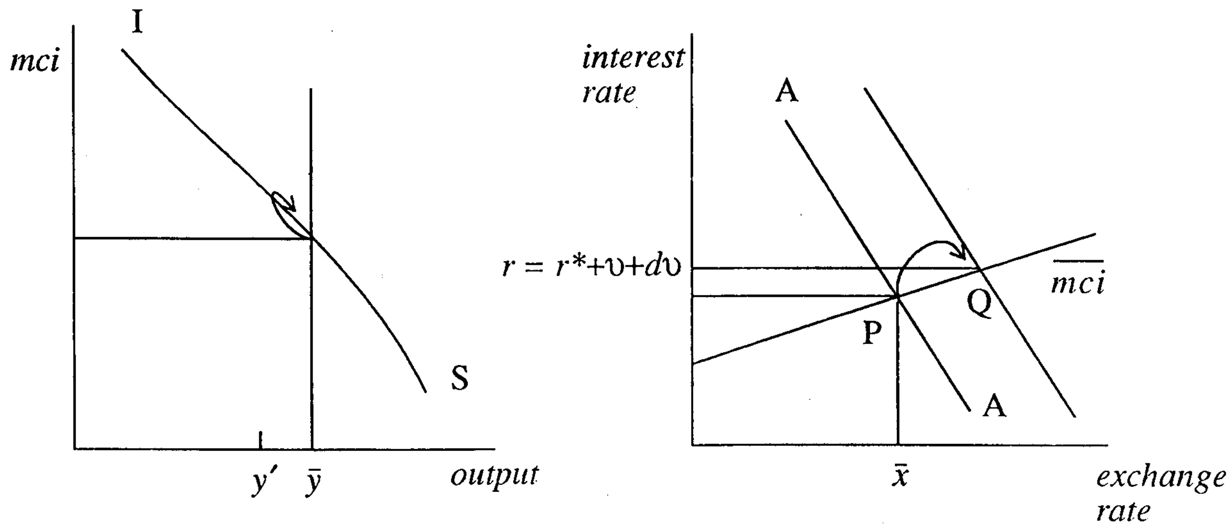
32 With rational expectations, the speed of adjustment represented by θ would be a function of all other parameters in the system.

33 A 1:3 ratio was adopted for use in the Bank's MCI index from a range of estimates for σ and δ .

34 A more complete model would embody endogenous asset stocks, as well as flows, and a steady-state equilibrium. This would allow the explicit tracing out of the intertemporal effects of fiscal changes.

conditions is unaffected. The interest rate rises by $d\upsilon$, so the equilibrium exchange rate has to rise by δ/σ times $d\upsilon$.

Figure A2

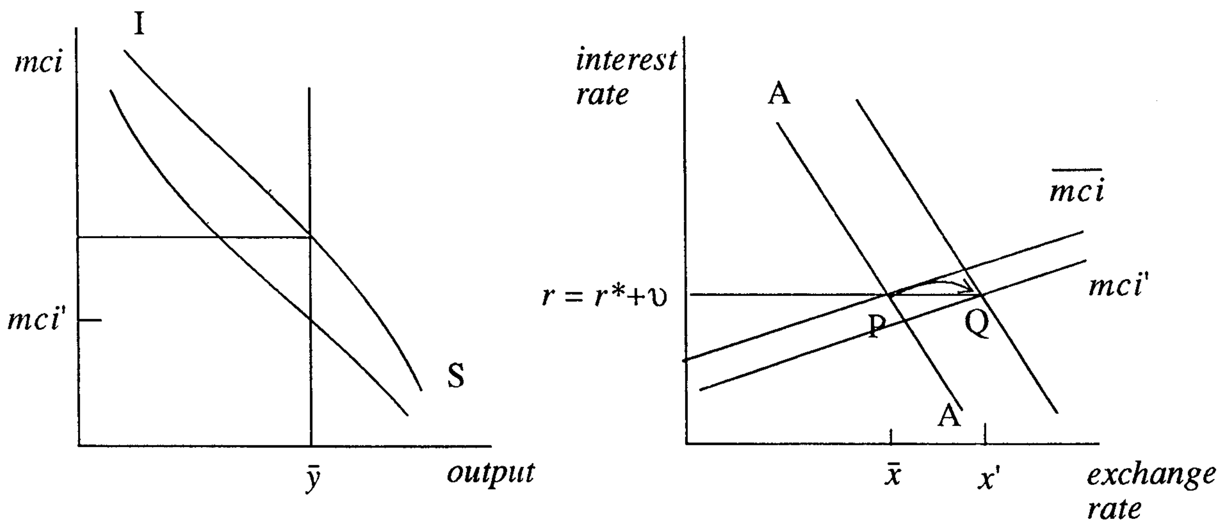


In effect, the higher interest rate compresses domestic demand, while the higher exchange rate creates an exactly offsetting increase in net exports, to maintain full-employment. However, either the increase in consumer prices would temporarily exceed target, because of the exchange rate feed-through, or monetary conditions would be tightened in the short run. In general, there would be some overshooting of the interest rate, as per the arrows in Figure A2. This keeps the price level closer to target by (a) moderating the increase in price of foreign exchange, and (b) creating some excess capacity, $y' - \bar{y}$.

Regardless of the way the target is approached, the economy suffers in the short run from a worsened policy trade-off: inflation is higher, or unemployment is higher.

Household confidence shock

Figure A3

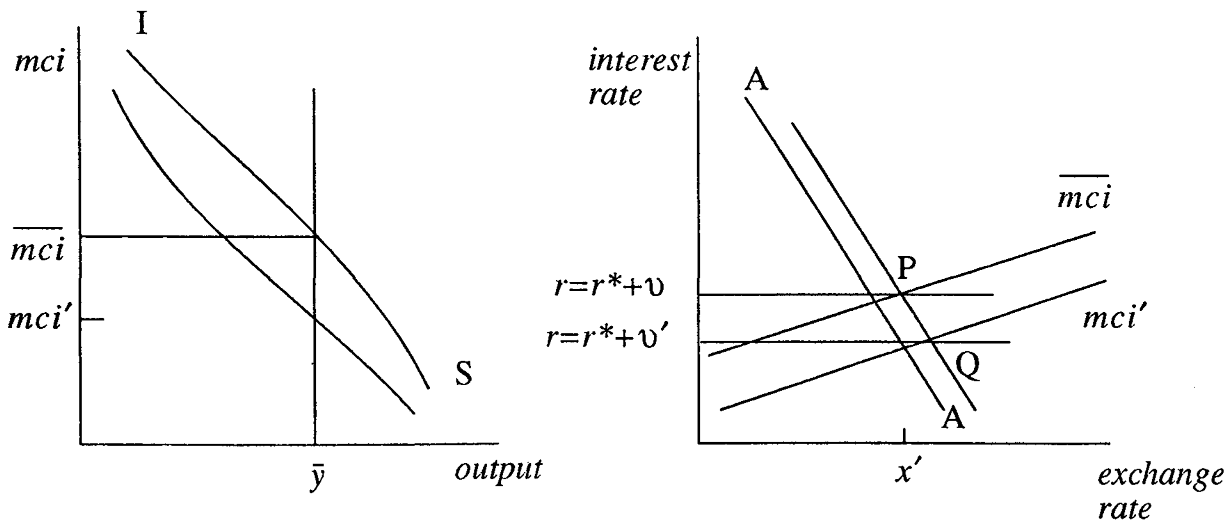


Reluctance of households to spend is represented in the model by m in equation A5, and is graphed as a downward shift in the IS curve in Figure A3. This contractionary disturbance requires a new equilibrium in which monetary conditions relax to mci'. But this in turn requires a depreciation and here, too, a CPI inflation target would generally not allow the exchange rate to adjust immediately. Even if the MCI declines steadily, as in the figure, the interest rate will generally be above its equilibrium value during the process of adjustment. In any case, the upward pressure on the exchange rate again worsens the policy trade-off.

Budget retrenchment

A possible short-run effect of budget retrenchment is illustrated in Figure A4. The spending cut shifts the IS curve downward, lowering the equilibrium MCI to mci'. At least part of the required easing is achieved by a decline in the interest rate, as the risk premium falls from υ to υ'. In general, this risk premium effect would not exactly offset the short-run effect on total spending, and some change in the exchange rate would also be required. In the figure, exchange depreciation occurs as the equilibrium moves from P to Q. But by making the risk premium reduction larger, it would easy to set up examples in which the exchange rate remains the same or appreciates.

Figure A4



2. Expectations model of the Canadian long-term interest rate

The expectations theory asserts that the yield on a T-period bond at time t is equal to an average of the current one-period rate plus the expected one-period rate for the next T periods, plus a term-risk premium, u_t:[35]

$$RL_t = \frac{1}{T}\left(R90_t + \sum_{i=1}^{t-1} ER90_{t+i} \right) + u_t \tag{A9}$$

An identical process would hold abroad.[36] We also assume:

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[35] This is a linear approximation to the time-discounted average, which has geometrically declining weights; see Campbell and Shiller (1991). The argument here is not affected by this simplification.

- the ***longer run equilibrium*** nominal exchange rate is a random walk. That is, beyond some point in the future, $t+J$, bond investors expect the period-to-period change in the price of foreign exchange to be zero;[37]
- bond investors realise that the current price of foreign exchange may differ from the longer run equilibrium price, because of the short-run stickiness of output prices. This implies that monetary policy can independently affect the domestic interest rate through a liquidity mechanism. This effect is assumed to have a maximum duration of J periods.

These assumptions imply that beyond date $t+J$ the domestic short-term interest rate is expected to converge to the foreign interest rate plus a country risk premium, υ_t, which would compensate for the risks of exchange rate changes and default:

$$R90_{t+i} = R90^*_{t+i} + \upsilon_{t+i} \qquad \text{for } i \geq J \tag{A10}$$

The difference between domestic and foreign bond yields may then be written as:

$$RL_t - RL^*_t = \frac{1}{T}\left[R90_t - R90^*_t + \sum_{i=1}^{J-1}\left(ER90_{t+i} - ER90^*_{t+i}\right) + \sum_{i=0}^{T} v_{t+i} \right] \tag{A11}$$

Under a wide range of assumptions about the path by which the short-term interest rate approaches its long-run equilibrium level, this can be simplified to:

$$RL_t - RL^*_t = \gamma\left(R90_t - R90^*_t\right) + \upsilon_t, \tag{A12}$$

where υ_t is the sum of country risk premium terms at the end of equation A11. As an example of how γ might be interpreted empirically, consider the linear process of adjustment depicted in Figure A5. Linearity provides a good approximation to a variety of economically interesting profiles, e.g. the partial adjustment model.

The initial one-period interest rate differential is $R90_0 - R90^*_0$. For simplicity, υ is assumed to be constant over the term horizon i = 0,1,...J,...T. The future expected short-term differential is then equal to v. Arrows indicate the expected adjustment path of the short-term rate. The area between this path and the zero axis corresponds to the summation enclosed in square brackets in equation A11. It is equal to $Tv + \left[\left(R90_0 - R90^*_0\right) - v\right]J/2$. In equation A12 this would imply: $\gamma = J/2T$. This would also hold for the more general case in which the term risk premium rises along the yield curve. We may use this approximation to infer the value of γ. $R90$ has a one-quarter and RL an over-10-year term, so that T is equal to at least 40. The horizon J would be roughly equal to 8 quarters, on the usual view of the duration of real effects of monetary policy. This would imply an "armchair estimate" for γ of about 0.10.

- Regardless of the precise specification of the adjustment path, the expectations model clearly implies that, unless they have long-term effects on the expected rate of inflation, independent changes in monetary conditions in Canada should have

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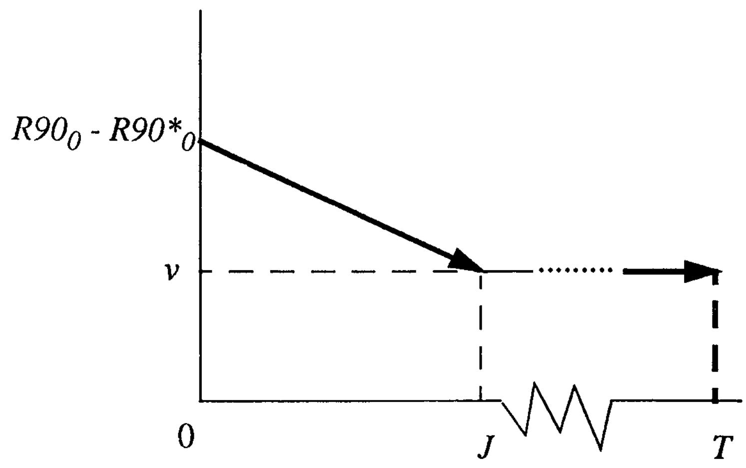
36 Without loss of generality one may also assume that the domestic and foreign term-risk premiums are equal. A difference in term-risk premiums is not distinguishable from a term-specific foreign risk premium.

37 Constancy of the expected future nominal exchange rate has been a common assumption in empirical equations for Canadian bond yields. It reflects, among other things, that the rates of inflation in Canada and the United States over the long run have been similar.

essentially second-order effects on the long-term bond yield, whereas revisions to term risk premiums should have first-order effects. This follows simply from the smallness of J relative to T.

Figure A5
Term profile of short-term interest rate and risk premium



3. Decomposition of the Canadian term spread

The long-term nominal interest rate at a given point in time may be decomposed into the following elements:

- long-run rate of return on real capital investment, $\bar{r}_t$. In Canada it is reasonable to assume that over time innovations in the underlying real return to capital follow the same path as those in the United States. Thus $\bar{r}_t$ can be thought of as the common North American long-run real return.
- term risk premium, υ_t
- long-run expected inflation, $E\overline{\Delta p_t}$
- short-term real interest rate, r_t, determined in the short run by monetary policy
- short-term inflation rate, Δp_t, predetermined in the short run.

The long-term interest rate can then be written as the weighted sum of long-term and short-term components:

- $RL_t = (1-\gamma)\left(E\overline{\Delta p_t} + \bar{r}_t\right) + \gamma\left(r_t + \Delta p_t\right) + \upsilon_t$ (A13)

with $R90_t = r_t + \Delta p_t$ the term spread may be written:

$$RL_t - R90_t = (1-\gamma)\left[\bar{r}_t - r_t\right] + (1-\gamma)\left[E\overline{\Delta p_t} - \Delta p_t\right] + \upsilon_t. \qquad \text{(A14)}$$

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Recent developments in the implementation of monetary policy in Japan and its operating procedure[1]

Kazuhiko Ishida

Introduction

In Japan, there have recently been a number of unprecedented developments in the implementation of monetary policy and its operating procedure. For example, the current level of the official discount rate (ODR hereafter) is not only at a historical low but is in fact lower than experienced in any other major country. Moreover, the overnight call rate, the most representative short-term money market rate, is below the ODR, which is quite divergent from past practice. The traditional role of BOJ (Bank of Japan) lending in the management of money market conditions has also been reviewed and undergone change. Most of these developments reflect BOJ's response to the changing financial and economic environment and its effort to maintain and enhance the effectiveness of monetary policy under new circumstances.

The purpose of this paper is i) to review the recent major developments in the implementation of monetary policy in Japan and its operating procedure in detail, and ii) to try to give a proper explanation or interpretation of these developments against the financial and economic background. In the following, recent changes in monetary policy operating procedure will first be discussed. Then, developments in monetary policy, mainly since the beginning of the current easing phase (from 1991), will be reviewed, with particular reference to the role of monetary aggregates, asset prices, and the foreign exchange rate. Comparison will also be made with the previous easing phase in the late 1980s, which was associated with the so-called asset price bubbles. Finally, Appendix I gives empirical analyses of quantitative indicators used to assess the extent of tightness or ease of monetary policy. Appendix II gives a summary of our recent empirical analyses concerning the relationship between monetary aggregates (mainly M2+CDs) and price/income variables.

1. Recent changes in monetary policy operating procedure

Recent changes in the financial and economic environment have resulted in significant changes in monetary policy operating procedure. In particular, the development or improved efficiency of various financial markets, which has emerged as a result of financial deregulation, has enabled BOJ to mainly rely on the market mechanism in conducting monetary policy. Main features of recent changes and resultant current procedure will be summarised in the following. It should, however, be noted that, in order to maintain the effectiveness and credibility of monetary policy, operating procedure should be constantly reviewed and further modified, if necessary, in accordance with possible changes in the financial environment. Certain factors which are expected to lead to such changes, namely i) the introduction of a repo market, and ii) the possible introduction of RTGS (real-time gross settlement) to the inter-bank settlement practice, will be discussed later in this section.

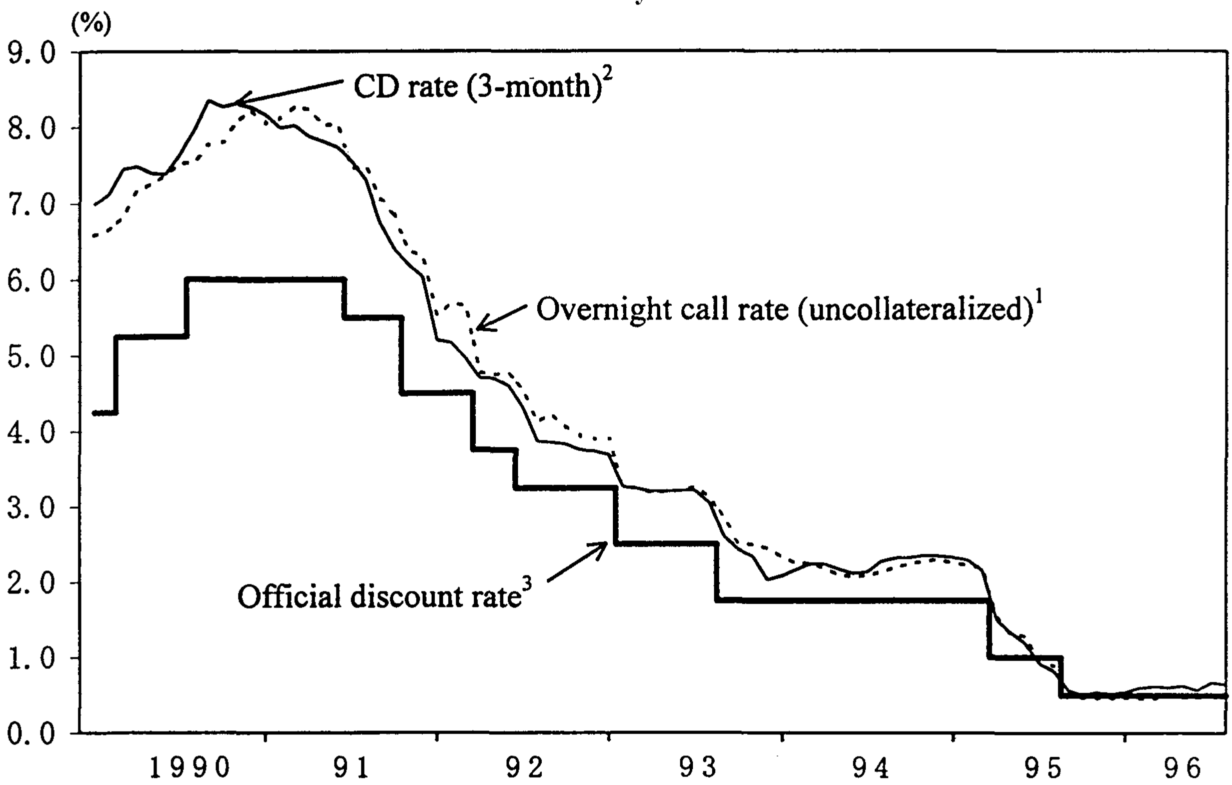
1 Prepared for the autumn meeting of central bank economists, held at the BIS on 28th-29th October 1996. The views expressed are those of the author, and do not necessarily represent those of the Bank of Japan. The author is grateful to Mr. Masayuki Matsushima for his helpful comment and suggestions, as well as to Mr. Tetsuya Hiroshima and Mr. Hidemi Kataoka for their support in empirical works.

1.1 Changes in the role of the short-term money market rate and the ODR

The most conspicuous feature of recent changes in monetary policy operating procedure is the increased importance attached to the adjustment of market interest rates, in particular, the overnight call rate. BOJ has consistently paid due attention to developments in market rates, and, in fact, implicitly controlled the overnight call rate so that it would move in line with changes in the ODR and normally stay at a level slightly above it. In March 1995, however, BOJ for the first time explicitly announced its intention to lower market interest rates without cutting the ODR. Like changes in the ODR, this measure was based on a decision of BOJ's Policy Board, which is the ultimate decision-making body with respect to monetary policy.

In July 1995, when BOJ decided and announced the further lowering of market interest rates,[2] the level to which it intended to bring the overnight call rate (on average), and which was lower than the ODR, was also made explicit. This announcement, in fact, denotes a distinct change in monetary policy operating procedure in two aspects: i) this was the first time for BOJ to announce such a guidance level for market interest rates, and ii) this was also the first occasion that the overnight call rate was brought to a level lower than the ODR[3] (Figure 1). A new guidance level was again announced when the ODR was further cut by half a percentage point to 0.5% in September 1995.[4]

Figure 1
Short-term money market rates



[1] Figures are monthly average rates. [2] Weekly average rates for the last week of the month, weighted by the volume of CDs issues during the month by city banks, long-term credit banks and trust banks belonging to the Federation of Bankers Associations of Japan. Trust banks which opened in or after October 1993 are excluded. [3] End of month.

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2 Between these two occasions (March 1995 and July 1995), the ODR was cut by ¾ percentage points to 1.0% in April.

3 The actual announcement was: "(BOJ) expects that short-term market rates on average will decline somewhat below the ODR".

4 The announcement was: "(BOJ) expects that short-term money market rates on average will decline slightly below the new ODR".

These measures have given rise to money market conditions that are totally different from those in the past. In the past, the practice whereby the overnight call rate was guided by BOJ, although implicitly, to a level above the ODR was one of the most important features of monetary policy operating procedure. This practice created persistent excess demand for BOJ lending provided at the ODR, and, consequently, BOJ had considerable discretion whether or not to activate lending. BOJ used this discretionary power to affect money market conditions. Under the new procedure, however, since the ODR is, on average, higher than the overnight call rate, commercial banks normally choose to raise funds, when necessary, from money markets at market rates, and hence there is no persistent excess demand for BOJ lending.[5] Thus, the previously substantial role of the ODR has changed, and the primary concern of monetary policy operations is the adjustment of the overnight call rate. A remaining important role of the ODR, for the moment, is that it indicates changes in the basic stance of monetary policy.

There are still certain issues to be further examined or solved concerning this new operating procedure. For example, as mentioned before, only the average level to which BOJ intends to bring the overnight call rate is made explicit. Alternatively, it is also conceivable that BOJ could announce a target range rather than the average, which would make it clearer what degree of variance BOJ was prepared to tolerate.[6] It is also yet to be considered and decided whether or not the current practice of bringing the overnight call rate to a level lower than the ODR should be permanently maintained.

1.2 Increased use of market operations and withdrawal of BOJ lending

Since the ODR is on average higher than the overnight call rate under the new operating procedure and excess demand no longer exists, it has become difficult for BOJ to use ODR lending as the main instrument to influence market interest rates. BOJ has responded to this situation by increasing the use of various market operations. In fact, since July 1995, the frequency of certain operations, such as same-day competitive bidding operations for treasury bills, outright JGB (Japanese government bonds) purchase operations, and bond *gensaki* operations (purchases with resale agreements), has increased. Competitive bidding was also introduced to same-day settlement bill-purchasing operations, which used to be based on "price limit" in which the purchase price had been specified by BOJ. CP operations were also resumed for the first time since 1991, with the method also changed to competitive bidding and participants extended to include banks and securities companies[7] (Figure 2).

This increased use of market operations, along with the above-mentioned new practice of maintaining the overnight call rate below the ODR, has significantly reduced the role of BOJ lending in influencing money market conditions. Taking account of these developments, BOJ reviewed the role of its lending and finally decided to refrain from using it, in principle, as a tool for market adjustment.[8] BOJ lending is now basically reserved for providing liquidity to financial institutions as the lender of last resort (LLR).

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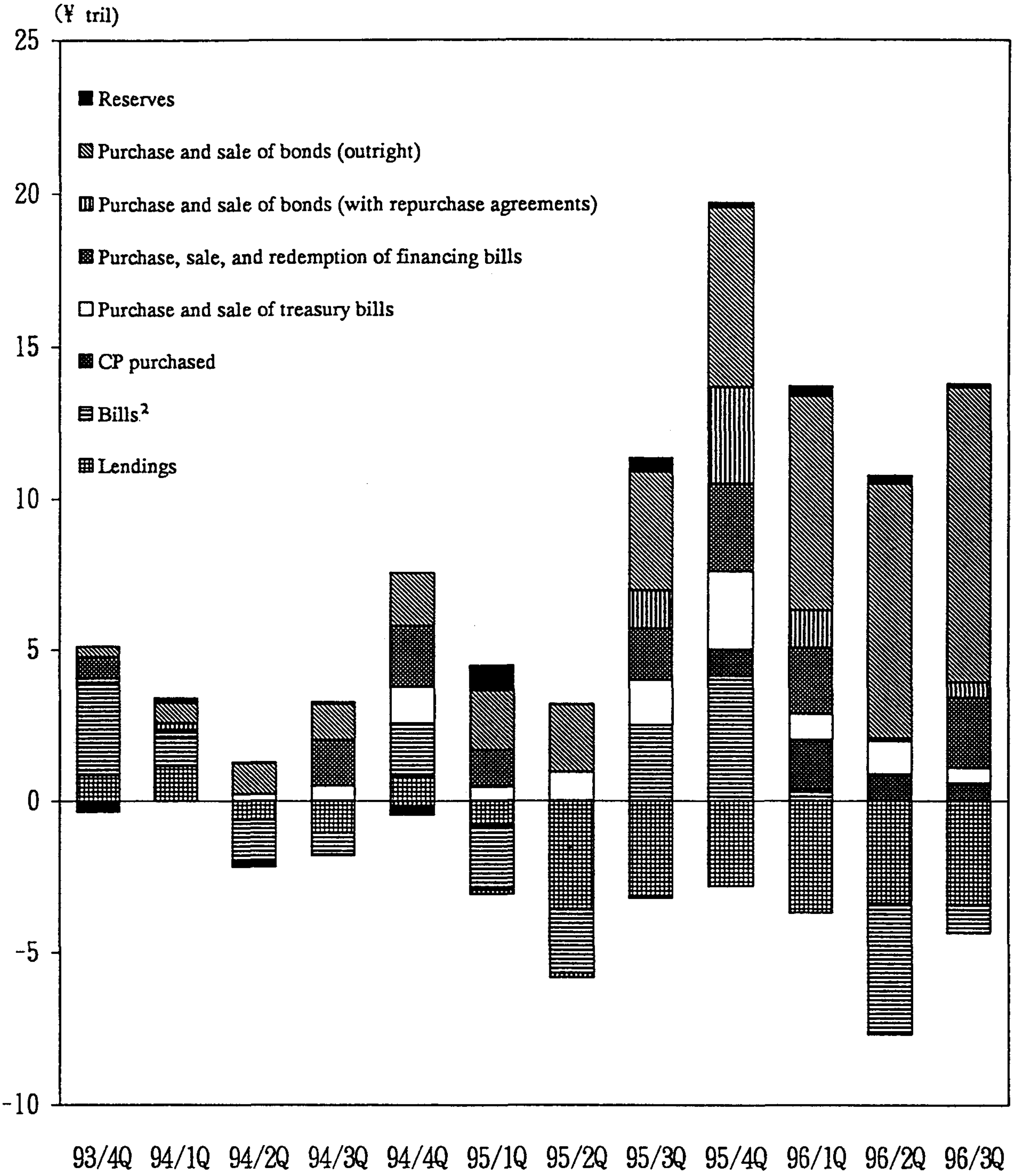
5 Of course, excess demand for BOJ lending could sometimes arise even under the new procedure, for example, when the market rate temporarily goes above the ODR due to exceptionally large fluctuations in factors affecting market liquidity (such as very large receipts of treasury funds).

6 Setting a target range for the overnight call rate could, of course, pose certain problems. For example, the range should be wide enough to allow seasonal or daily fluctuations in the rate caused by exogenous factors such as the net receipt of treasury funds, which are in fact quite large. On the other hand, excessively wider ranges could make BOJ's policy intention more ambiguous, possibly resulting in diminished transparency.

7 In the past, CP operations were only available to money market dealers (*tanshi* companies).

8 Heavy reliance on BOJ lending at below market rate in monetary policy operating procedure has also long been criticised as i) giving *de facto* subsidies to banks, and ii) lacking transparency concerning the allocation of lending

Figure 2
Bank of Japan credit operations[1]

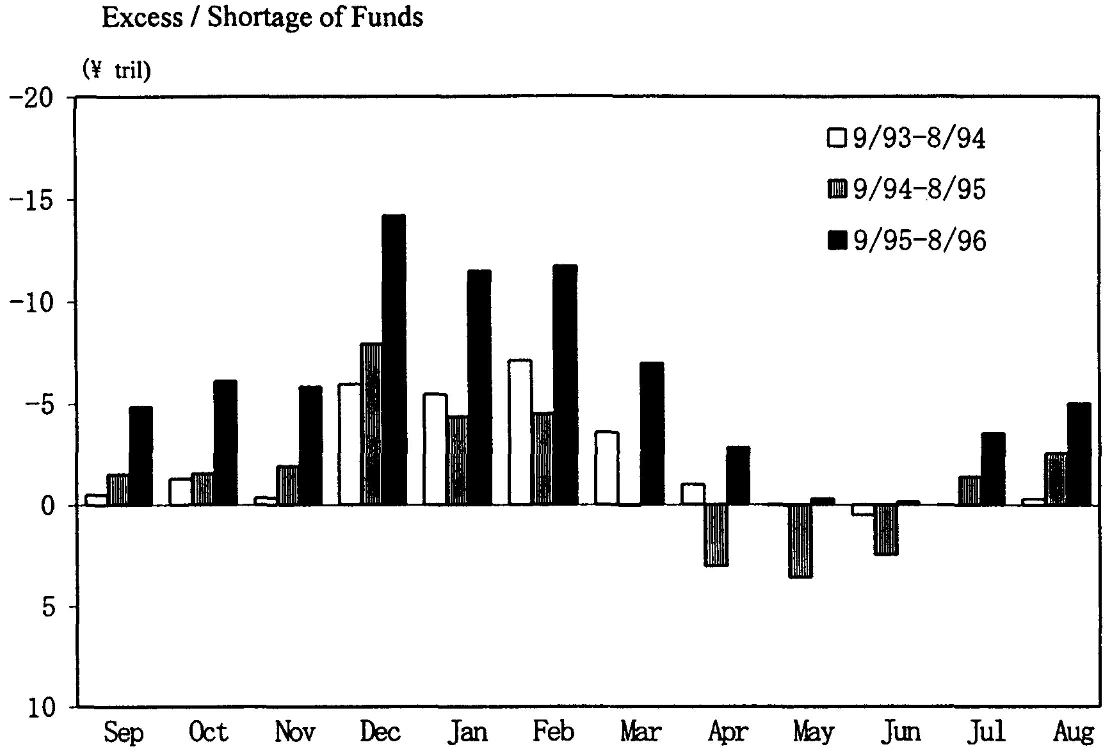


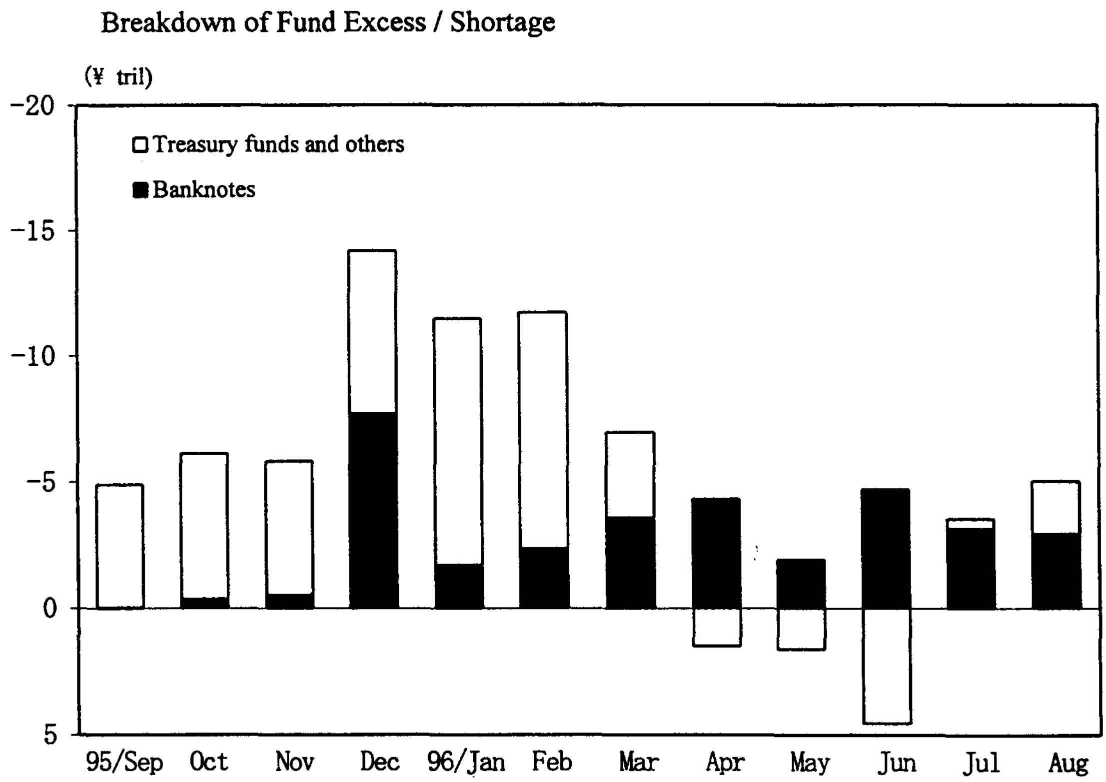
[1] Based on cumulative figures from 4th quarter 1993. Positive figures indicate supply of funds. [2] Bills = Bills purchased + bills sold.

One of the consequences of these developments has been an increase in the outstanding balance of the outright purchase of JGBs by BOJ since autumn 1995. Outright JGB-purchasing operations used to be regarded, in principle, as a means of providing the financial system with the additional reserves demanded in line with an increase in money stock, which is indispensable for

because of its bilateral nature. The recent change in the role of BOJ lending will reduce the significance of these problems.

Figure 3
Supply of and demand for funds*





* Figures are cumulative figures from September. Negative (positive) figures denote shortage (excess) of funds.

economic growth. The increase in purchases since autumn 1995, however, seems to be far larger than needed for this purpose. It is thus often put forward that BOJ has been trying to bring down long-term interest rates by increasing outright purchasing operations. However, this does not seem to be a proper understanding. The operations themselves were conducted mainly to offset a liquidity shortage in the money market caused by the significant increase in the net receipt of treasury funds (Figure 3), and hence were not in any way intended to supply extra liquidity. In addition, the resultant increase in the outstanding balance of outright purchases is to be regarded as just substituting the balance of BOJ lending, which is decreasing gradually.

1.3 Factors likely to cause further change in operating procedure

As stated at the beginning of this section, monetary policy operating procedure should, and is likely to, change further, in accordance with future developments in financial markets. Two particular factors which are likely to cause such changes in the near future: the introduction of a repo market, and the introduction of RTGS (real-time gross settlement) to inter-bank settlement practice in the future.

1.3.1 Introduction of a repo market

A repo market was introduced in April 1996. Formally, it is a market for lending/borrowing bonds (mainly JGBs) with cash offered as collateral. However, since it is now allowed for lenders of bonds to pay any interest on cash offered to them as collateral,[9] the market is expected to function as a *de facto* short-term money market. In Japan, the secondary markets for treasury bills (TBs) and financing bills (FBs), generally regarded as the most suitable markets for central bank operations because no credit risk is involved in the instruments traded, may not be sufficiently developed owing to certain obstacles, such as the withholding tax imposed on interest payments. Given this situation, the repo market is naturally expected to become one of the main markets for BOJ's operations, provided that it becomes sufficiently large.

In terms of size, the market has gradually expanded since its introduction: transaction volume increased from ¥17 trillion in April to ¥55 trillion in August 1996, and the outstanding balance from ¥3 to 6 trillion. However, transactions are mainly made for facilitating the short sale of bonds by securities companies, and hence the market so far does not seem to be functioning as a short-term money market as expected. Certain factors which are preventing the development of the market are pointed out. It is, for example, argued that the separation of decision making between bond and short-term fund dealing sections within financial institutions is an obstacle to growth of repo market. The most important factor, however, is said to have been the inconvenience associated with the settlement practice of JGBs, because, until September, settlements could only be made on certain designated days. This practice is now being changed to the so-called rolling settlement method: from 1st October, settlement is to be made seven days after the contract, and this is planned to be shortened to three days in March next year. This introduction of rolling settlement is expected to contribute to the further development of the repo market and, if the market grows sufficiently, it is possible that BOJ might start utilising it to effect operations.

1.3.2 Introduction of RTGS in the future

In Japan, most inter-bank settlements are effected on a DTNS (designated time net settlement) basis, although RTGS is also institutionally possible and BOJ-NET, the principal inter-bank settlement system run by BOJ, facilitates both. However, BOJ is considering changing this

9 There used to be a ceiling on interest paid on cash offered as collateral (the ceiling was one percentage point lower than the collateralised overnight call rate), which had prevented the development of a repo market.

practice to make RTGS the principal method for inter-bank settlement, in order to reduce systemic risk involved in DTNS-based settlement.

Under current practice where DTNS is dominant, the average outstanding balance of reserves which banks need to hold for daily settlement operations is quite small, and normally below the level necessary for meeting minimum reserve requirements.[10] In this situation, daily fluctuations in demand for reserve balances needed for settlement purposes are absorbed in changes (leads or lags) in banks' "progress ratios" to meet reserve requirements. Theoretically, this means that banks have a certain degree of discretion in determining their daily holding of reserves, depending on the overnight call rate or its prospects, and hence the demand curve of banks with respect to reserve balances each day is downward sloping against the interest rate (not vertical). Given this, BOJ is able to affect the overnight call rate by controlling the daily supply of reserves through market operations; that is, deciding whether or not to fully offset the liquidity excess/shortage each day, and hence affecting the "progress ratio". In fact, this is the main mechanism by which BOJ controls the overnight call rate under current operating procedure.

If inter-bank settlements come to be mainly on an RTGS basis, the way of controlling the overnight call rate could also change. In fact, the daily volume of inter-bank settlements far exceeds the average reserve balance currently held by banks to meet reserve requirements. Hence, without provision of intra-day liquidity by BOJ, daily demand for reserves could be mainly determined by settlement volume and would not respond to the overnight call rate. If this situation actually prevails, the above-mentioned method for controlling the overnight call rate through affecting the "progress ratio" could not work under RTGS.

Although the most appropriate operating procedure under RTGS is not yet clear and is a subject for further study, one apparent problem to be solved, therefore, is how to provide banks with intra-day credit. As intra-day credit must be provided quite promptly to meet banks' demand and market operations conducted through competitive bidding might not ensure such promptness, the extension of some bilateral credit by BOJ is likely to become necessary. The most suitable way for BOJ to provide banks with intra-day credit, and its desirable conditionality (the applicable interest rate, eligible collateral, etc.) is currently being considered.

2. Implementation of monetary policy in recent years

Against the background of sluggish economic recovery, the easing of monetary policy has been underway in Japan since 1991. Indeed, the level of interest rates has fallen substantially below the low recorded in the previous easing period, which seems to evidence the unprecedented degree of monetary ease. In this section, we first try to assess the extent and effect of this continued easing, and to examine the possible risks involved. Then, the role of certain factors (such as monetary aggregates and policy response to exchange rate developments and asset prices), in the implementation of monetary policy in general, as well as in the current easing of monetary policy in particular, will be discussed.

2.1 Overall assessment of continued easing of monetary policy

Monetary policy in Japan turned to ease in 1991, and has continued easy since. The ODR has been lowered by a total of 5.5 percentage points to the historical low of 0.5%, and market interest rates have fallen accordingly (see Figure 1). The overnight call rate, in particular, has fallen even below the ODR, reflecting the change in monetary policy operating procedure since July 1995 (as

[10] In Japan's reserve requirement system, the reserves held by banks to meet the reserve requirement can also be used for their daily settlement purposes.

discussed in Section 1). This prolonged easing of monetary policy is, of course, mainly associated with the sluggish recovery of economic activity. Although the Japanese economy started to recover towards the end of 1993, the speed remained very slow compared with past recovery phases, and a pause was even feared in the first half of 1995 when the yen began to further appreciate.

Since the current easing period is already longer than the previous one, which was associated with the so-called asset price bubbles in the late 1980s,[11] and the current level of interest rates is far lower (the ODR bottom in the previous easing period was 2.5%), the argument is sometimes heard that there is a risk that the current easing of monetary policy could already be excessive. However, when assessing the appropriateness of current monetary policy, a number of factors influencing recent developments in the Japanese economy, such as changing trade and industrial structures and the damage caused by the bursting of the so-called bubbles, should be taken into account, and comparing the extent of ease just in terms of length or level of nominal interest rates is not necessarily the right way.

In fact, during the current phase of recovery, continuing adjustment pressures stemming from the factors mentioned above are likely to have made the recovery slower than previous ones. For example, there has been continued pressure for Japan's trade and industrial structures to change and adapt in accordance with the appreciation of the yen as well as the rapid industrialisation of Asian economies. Firms have responded to this pressure by investing abroad rather than domestically, and hence shifting some of their production overseas. Accordingly, corporate investments have been more sluggish than is normal during a recovery period. In addition, the rapid and large fall in asset prices, particularly land prices, after the bursting of the bubbles, has seriously impaired balance sheets in both the corporate sector and the financial sector, which has made firms and financial institutions less willing to take risks involved in investment. Many firms have also reduced investment to within the level of cash flow and are avoiding building up further financial liabilities.

These adjustment pressures have also substantially reduced the risk of overheating or the emergence of inflation and asset price bubbles. In fact, even after more than five years of monetary ease, the inflation rate has remained very close to zero, and there is no sign of asset prices regaining momentum. In this situation, it seems quite appropriate for monetary policy to try to mitigate the negative impact of adjustment pressures on the real economy by maintaining low interest rates, thus contributing to the smooth progress of such adjustments.[12]

There could be another argument with respect to the extent of monetary policy ease, which suggests that, taking account of the deceleration of inflation and the fall in the potential growth rate, monetary policy during the current easing phase has not actually been as easy as suggested by developments in nominal interest rates. In order to examine this argument empirically, we tried to develop a measure which enables us to quantitatively assess the real tightness or ease of monetary policy. We tentatively call the measure the "Monetary Thrust Index" (MTI hereafter) and it is defined as the difference between the real interest rate (real cost of funds) and the real rate of return on investment. Thus, monetary conditions can be regarded as stimulative (restrictive) if MTI is negative (positive). In calculating MTI, we actually subtracted the estimated potential growth rate (used as a proxy for the medium-term expected real rate of return on investment) from the real overnight call rate (the nominal call rate, which is the principal policy rate, minus GDP deflator growth). MTI thus calculated, in fact, has been empirically proved to cause (in a Granger sense) real M2+CDs (the representative monetary aggregate in Japan) and real domestic private demand (Figure 4). (For details of MTI calculation and empirical results, see Appendix I.)

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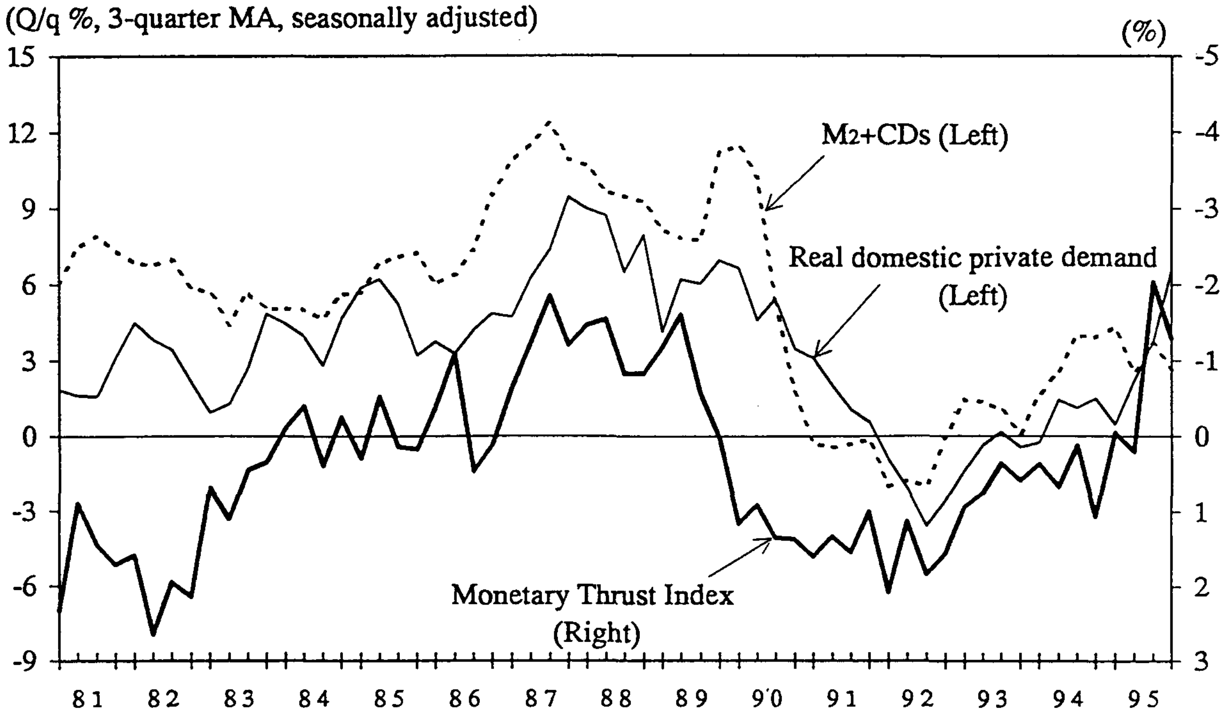
[11] The previous easing period is assumed to have started just after the temporary hike in short-term interest rates towards the end of 1985, which was aimed at bringing down the exchange rate of the US dollar in accordance with the Plaza Agreement.

[12] Low interest rates are believed to have substantially assisted the corporate sector in pursuing adjustment efforts by supporting corporate profit through reduced interest payments on liabilities. For detailed discussion, see Bank of Japan (1996).

Figure 4
Monetary Thrust Index, M2+CDs and real domestic private demand



Note: M2+CDs is deflated by the GDP deflator.

Examining the developments in MTI over time, it can be argued that the quantitative degree of monetary policy ease (in other words, the magnitude of "thrust" stemming from monetary easing) during the current easing phase since 1991 has not been as stimulative as is suggested by the large fall in nominal interest rates. In fact, MTI remained positive until around the end of 1994 (see Figure 4). There are, of course, several problems associated with MTI as calculated here; for example, a) the expected inflation rate used in calculating the real call rate is unobservable and there are various possibilities as to what proxy to use, and b) the estimation of potential growth is not unique and depends on the assumptions made. Thus, certain reservations should be made in interpreting MTI, and it is not necessarily appropriate to simply believe, for example, that a positive MTI means tight monetary policy. Nonetheless, if we compare developments in MTI during the current easing phase with those in the previous one in the late 1980s, it can somewhat safely be argued that the length and extent of easing was far greater in the previous phase.

2.2 Role of monetary aggregates

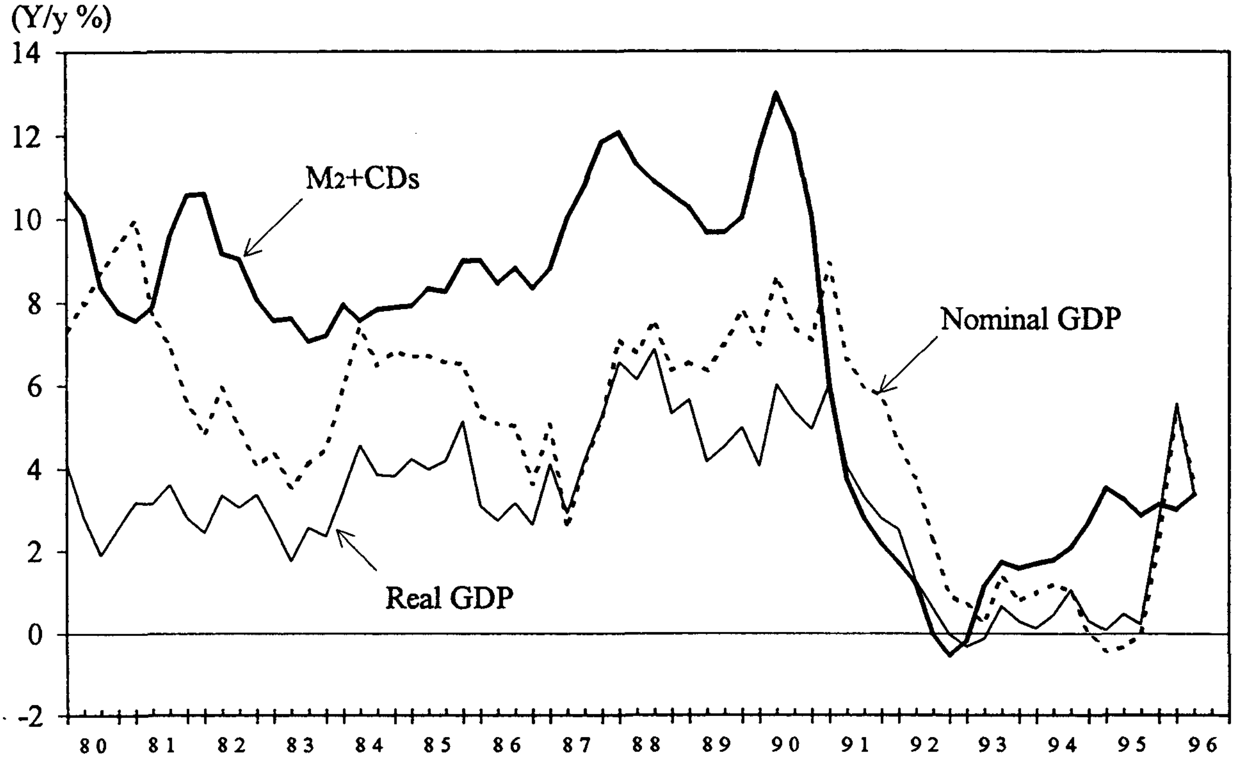
The implementation of monetary policy by BOJ has always been based on an overall judgement, and no targets have been set with respect to any specific economic or financial indicators. Thus, BOJ has never given the role of an intermediate target to monetary aggregates. Nonetheless, BOJ regards them as a most important indicator and information variable for monetary policy, and has continuously published "projections" for the most representative aggregate, that is, M2+CDs, since 3rd quarter 1978.[13]

During the current phase of monetary easing, the growth rate of M2+CDs has remained rather low compared with the past easing period, which has been one important consideration behind

[13] The projections are published in BOJ's "Quarterly Economic Outlook".

BOJ's policy decisions (Figure 5). In fact, in official statements published by BOJ when the easing measures were taken, the slow growth of M2+CDs has often been cited as one of the reasons which induced BOJ's decision.[14]

Figure 5
M2+CDs and GDP



If we look back further, however, it must be admitted that large fluctuations in monetary aggregates, particularly in M2+CDs, were allowed and did not attract sufficient attention in the implementation of monetary policy in the late 1980s and early 1990s. This was mainly because, at that time, the relationship between monetary aggregates and economic variables such as prices and income seemed to have become rather unstable, which was believed to have reduced, at least temporarily, the usefulness of monetary aggregates as an information variable for monetary policy. In fact, many empirical studies conducted during this period failed to confirm the stability of the money demand function or the money-income causality relationship.[15] Needless to say, the large and active shift of funds among financial assets within and outside monetary aggregates caused by the progress of the deregulation of deposit interest rates, as well as the influence of large fluctuations in asset prices on money demand, can be regarded as the main factors underlying the instability.

These factors appear to have subsided substantially in recent years. The influence of asset price fluctuations on money demand seems to have become less significant as asset prices have become more stable, although certain downward pressure is likely to continue stemming from the continuing fall in land prices. Since the deregulation of deposit interest rates has been completed and most rates now tend to move closely with market rates, the large and persistent shift of funds between

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[14] Every time easing measures have been taken since March 1995 (four times: in March, April, July and September 1995, with the April and September cases involving a cut in the ODR), reference to "the slow growth of money supply" was made in BOJ's statements explaining the background against which such measures were taken.

[15] For example, see Bank of Japan (1992).

deposits and other financial assets has become less likely.[16] It can, therefore, be expected that the relationship between monetary aggregates and various economic variables (such as income and prices) has, at least to a certain extent, stabilised. In retrospect, it is also possible that instability in the relationship between monetary aggregates and price/income variables was overly exaggerated in the empirical studies of the late 1980s and early 1990s since large fluctuations existed towards the end of the data series and hence the stable long-term relationship (for example, the tendency to return to the mean) was less likely to be statistically identified.

In fact, our recent empirical studies using the longer data series up to the most recent period suggest that the stable relationship between M2+CDs and price/income variables has continued for a long period, including the late 1980s and early 1990s. For example, the existence of a long-run equilibrium relationship between M2+CDs, the price level (GDP deflator), and real GDP has been confirmed using co-integration analysis. The M2+CDs demand function has also been found to be broadly stable, and money-income causality (in a Granger sense) holds for most cases. (For details of these empirical studies, see Appendix II.)

In the light of these developments, BOJ now fully utilises the information obtained from monetary aggregates in implementing monetary policy, and ensures over the long-term that the stable growth of monetary aggregates is achieved, although no rigid target ranges are yet set. If the growth rate of monetary aggregates is to be kept stable over the long-term, it would also function as a "nominal anchor", and contribute to preventing the excessive use of monetary policy as a tool for fine-tuning economic activity.

2.3 Asset prices and monetary policy

As already mentioned, at the moment there seems to be little risk of a re-emergence of asset price inflation, particularly an upsurge in land prices. In fact, although certain empirical results suggest that land prices have now become quite close to their theoretical level derived from, for example, the "net present value" model, there still is little sign that they have stopped falling.

Theoretically, there is no concrete answer concerning the extent to which monetary policy should attach importance to asset prices. It is, however, rather widely agreed that asset prices could be used as information variables for monetary policy implementation. Asset prices tend to respond to changes in various factors affecting the economy earlier than real economic variables. They could also contain information concerning expectations of future economic developments held by most market participants. In fact, in many empirical studies, it has been found that changes in asset prices precede those in real economic variables, and even those in monetary and other financial aggregates. It might, therefore, be useful for central banks to pay sufficient attention to information contained in asset prices in implementing monetary policy.

One empirical idea to facilitate the use of asset prices as an indicator is to formulate a kind of composite index including both the general price level and asset prices, with proper weights attached to both. Certain trials have already been made (Figure 6),[17] but their usefulness has not yet been sufficiently confirmed empirically, and they seem too primitive to be actually used.

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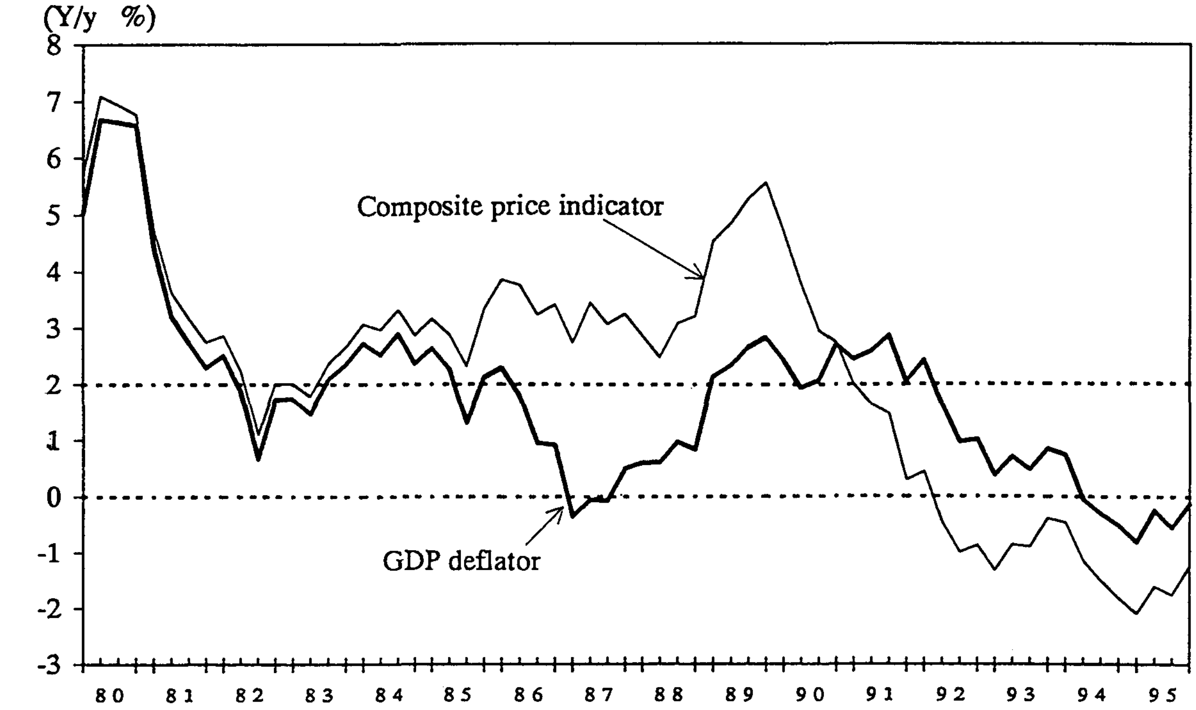
[16] A shift of funds caused by the temporary widening or narrowing of interest rate differentials among various financial assets, stemming from, for example, the difference in the adjustment speed of interest rates, could occur more frequently than before, because financial liberalisation has made such shifts easier. But, this kind of shift is not likely to persist long enough to affect real economic variables. A shift of funds could also be induced by factors other than interest rate differentials. One such factor which commands due attention at the moment is the changing perception of the soundness of various financial institutions. In fact, a shift of funds from small financial institutions and into postal savings is gradually taking place, which might reflect a greater concern for risks associated with private financial institutions, particularly smaller ones.

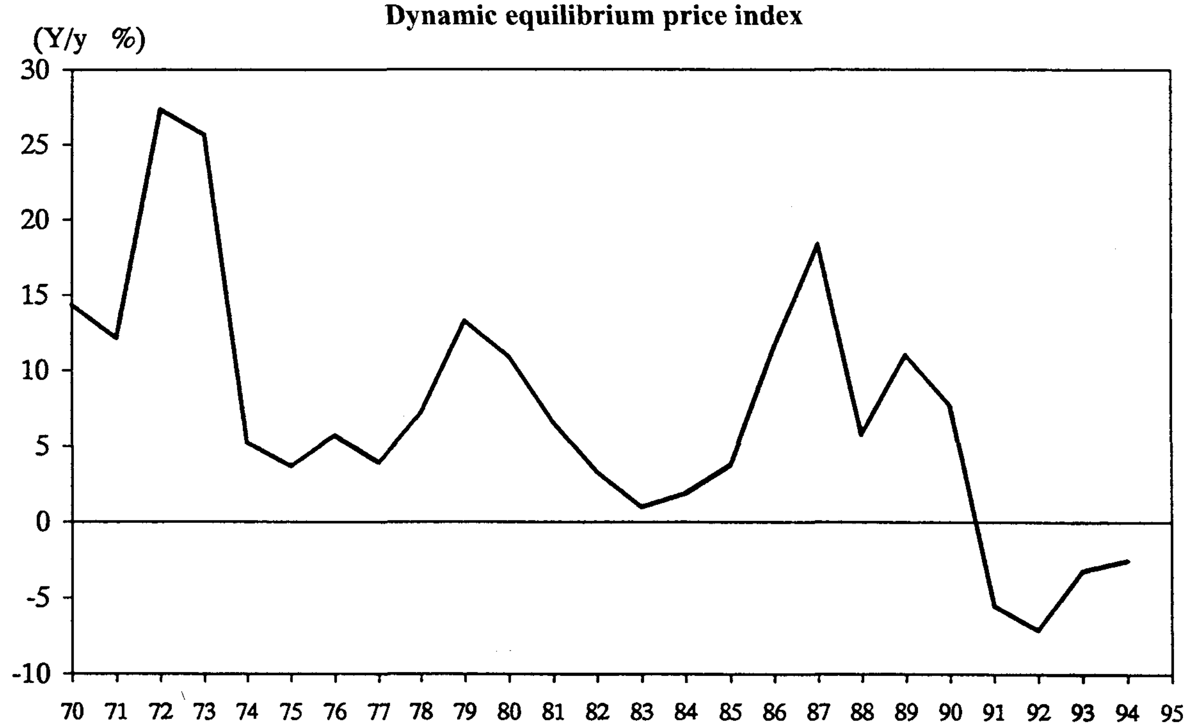
[17] At a first glance, the composite index shown in the upper panel of Figure 6 seems to be giving a reasonable signal. For example, no deceleration was observed from 1986 to 1988, which could have precluded excessive easing. The index

Figure 6
GDP deflator and composite price indicator



Note: Composite price indicator = 0.1* land price + 0.9* GDP deflator.

Dynamic equilibrium price index



Note: Geometric mean of changes in the GDP deflator and net national assets. Weights calculated using a modified version of the "golden rule".

also shows the need for tightening more clearly than does the GDP deflator around 1989. Although these facts could suggest the usefulness of this kind of index as an indicator of monetary policy, its properties must be examined further, including the appropriateness of the weights.

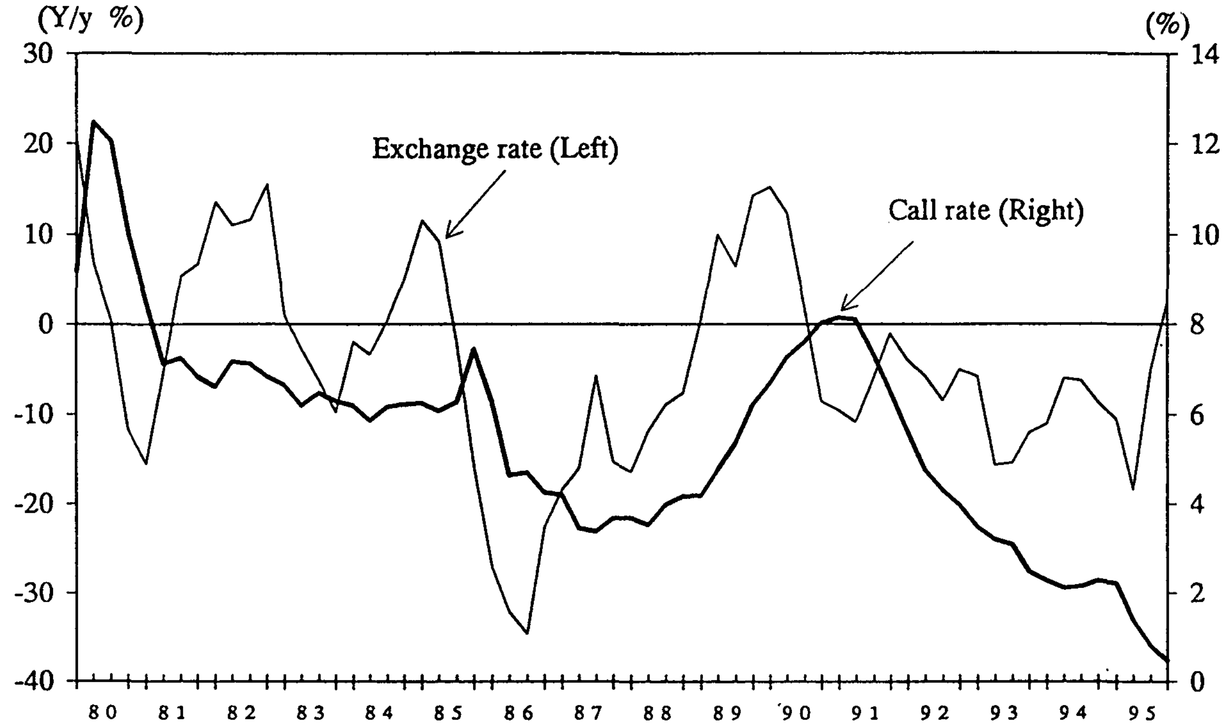
There seems to be far wider divergence of views concerning whether or not the stability of asset prices should be regarded as an objective of monetary policy. It is quite certain that the ultimate objective of monetary policy is to realise and maintain non-inflationary sustainable growth, which does not necessarily include stability of asset prices. Japan's experience since the bubble period, however, clearly shows that large fluctuations in asset prices could influence real economic activity, and hence the long-term objective of non-inflationary sustainable growth. Moreover, in the light of public sentiment, formed against the background of the experience of the bubble economy and the sharp rise in housing prices in particular, it would be impossible to completely ignore the stability of asset prices. The appropriate weight which should be attached to the stability of asset prices in the implementation of monetary policy remains a topic for future studies.

2.4 Exchange rate and monetary policy

Like asset prices, maintaining the stability of the foreign exchange rate itself is not regarded as an ultimate objective of monetary policy. In principle, and in the long-term, the exchange rate can be stabilised by putting the domestic economy in order through the proper management of macroeconomic policies. In fact, although offsetting the deflationary impact stemming from the rapid appreciation of the yen since the beginning of 1995 was one of several considerations leading to the series of easing measures taken since March 1995, halting the yen's appreciation was not regarded as a policy objective in itself.

The exchange rate can sometimes fluctuate considerably, and also diverge from economic fundamentals for a lengthy period. Since these volatile movements in the exchange rate, which may be justified by underlying real economic activity, and thus regarded as "exogenous", would significantly influence the stability of economic growth, it is sometimes necessary and also appropriate for monetary policy to give certain attention to the impact of the exchange rate on economic activity. However, risks involved in monetary policy that fully offsets the impact of the exchange rate have also become clear in light of the experience of the late 1980s.

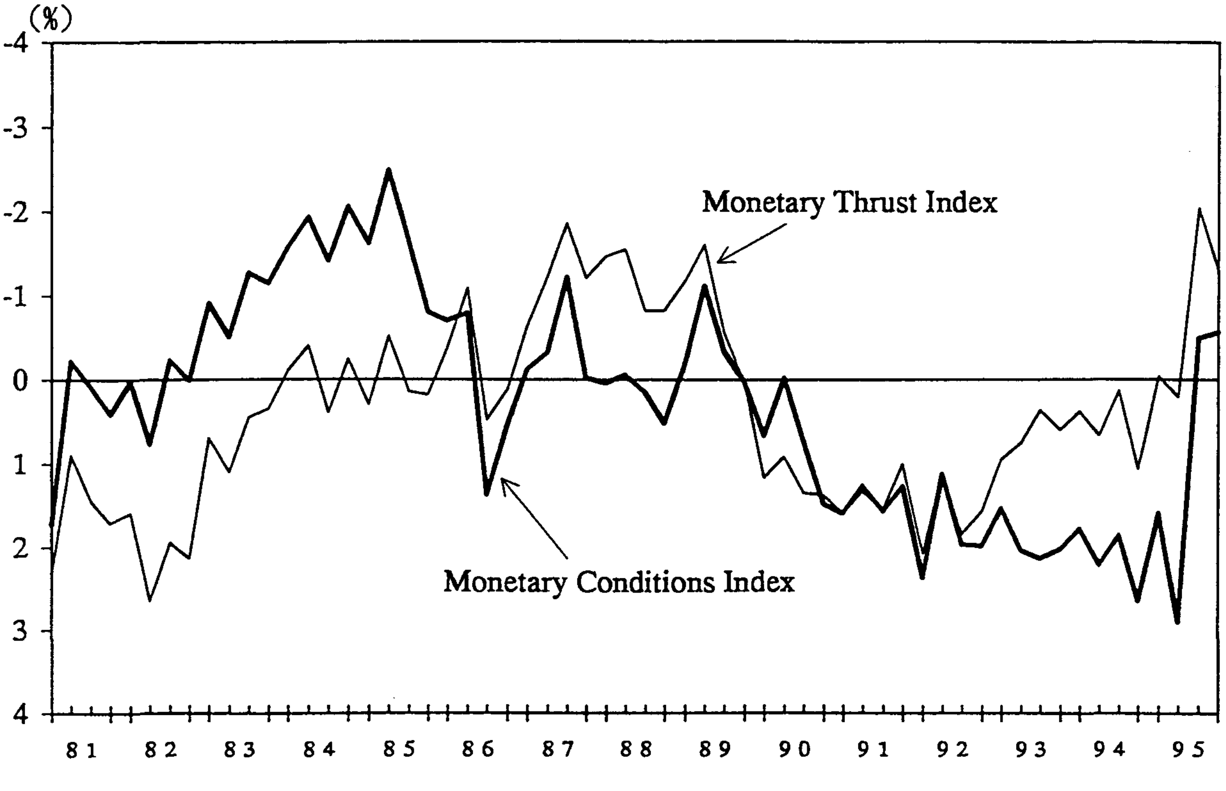
Figure 7
Exchange rate (¥/$) and the call rate



In the late 1980s, when the yen appreciated rather rapidly, the deflationary impact was perceived to be unprecedented, and thus really serious for the Japanese economy. It was therefore thought that offsetting this deflationary impact was a most urgent task for monetary policy. In retrospect, it cannot be denied that, reflecting this perception, the weight attached to exchange rate considerations in the implementation of monetary policy during this period was excessively increased. It can actually be seen that developments in the call rate during this period were rather strongly affected by the exchange rate (Figure 7).

As already explained in 2.1 above, if we evaluate the quantitative thrust of monetary policy during this period using MTI, the easing was quite substantial and prolonged. However, an assessment using the Canadian type MCI (Monetary Conditions Index) indicates that the monetary policy thrust was not that easy, if we take the deflationary impact stemming from the appreciation of the real effective exchange rate into account (Figure 8). (For details of the calculation of MCI in Japan's case and empirical analysis using it, see Appendix I.) In fact, MCI remained, on average, almost neutral from 1986 to 1988, which suggests that the extent of monetary easing during this period was no more than needed to offset the deflationary impact of the appreciation of the yen. Nonetheless, in retrospect, this easing of monetary policy proved to have been one of the main reasons for asset price bubbles,[18] confirming the risk involved in a monetary policy intended to fully offset the impact of exchange rate changes (or other exogenous factor) on total demand and hence GDP.

Figure 8
Monetary Condition Index and Monetary Thrust Index



Note: MCI = real effective exchange rate (% change from base period, 4th quarter 1989) *0.1 + Monetary Thrust Index.

Empirical studies conducted in Appendix I show that monetary policy mainly affects domestic private demand, at least initially, rather than total GDP. Thus, easing monetary policy to offset the deflationary impact of the exchange rate tends to create growth which is heavily dependent

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18 For an analysis of the various factors, including structural ones, which caused asset price inflation in many industrialised countries, see Shigemi (1995).

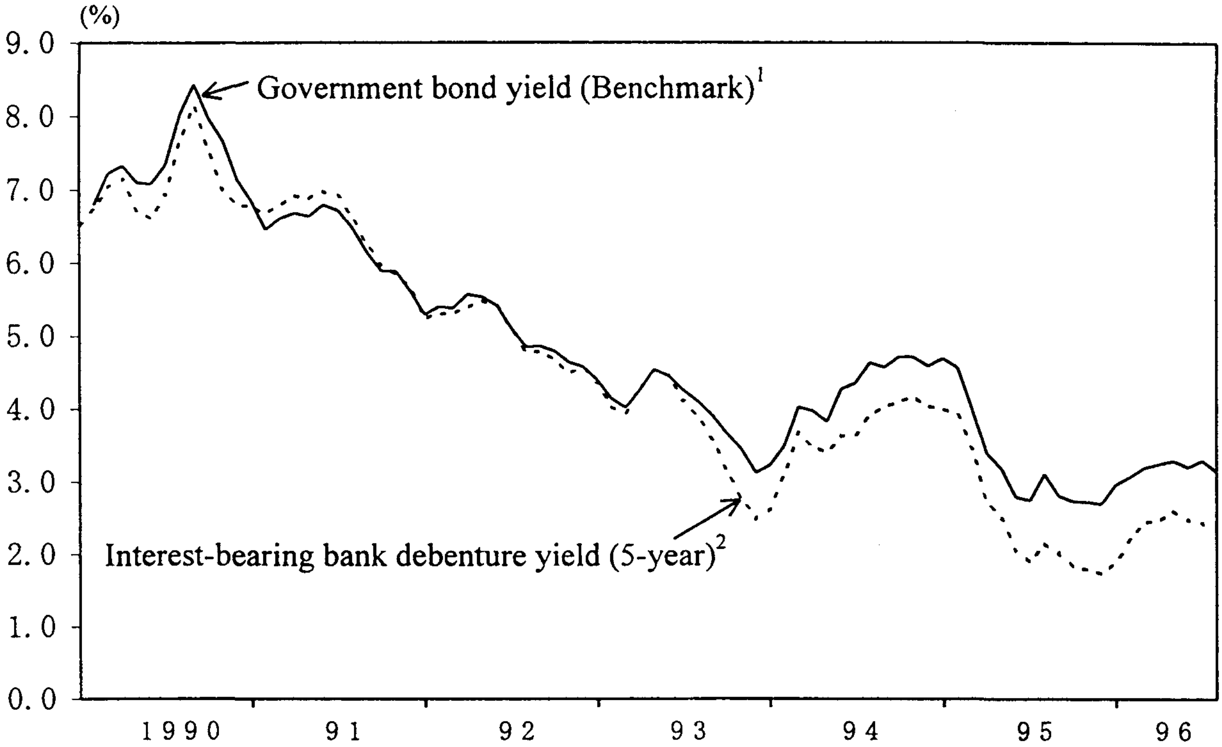
on domestic private demand, as was the case with the expansion of the economy in the late 1980s. It is quite probable that this source of growth triggered the rapid rise in land prices by creating excess demand for land, a most typical "non-tradable" good.

2.5 Monetary policy and long-term interest rates

Long-term interest rates are generally thought to be more important than policy-induced short-term rates as a factor influencing such economic activity as business fixed investment and household residential investment. Thus, developments in long-term interest rates or the shape of the yield curve should be carefully monitored in implementing monetary policy. Since long-term interest rates are strongly influenced by market participants' expectations with respect to the future course of short-term rates or inflation, as well as their actual development, it could sometimes occur that long-term interest rates will not move in the direction consistent with monetary policy.

This actually happened during the current phase of monetary easing in Japan. While the easy stance of monetary policy has been maintained and short-term interest rates have continuously been kept low, there were two instances when long-term interest rates rose significantly: once in late 1994 and the other from the beginning of 1996 until August (Figure 9). These hikes in long-term interest rates are thought to be caused by fluctuations in market participants' expectations concerning the future course of monetary policy.[19]

Figure 9
Long-term market rates



[1] Figures are monthly average rates. [2] Figures for bank debentures by the Industrial Bank of Japan. Based on over-the-counter offer quotations.

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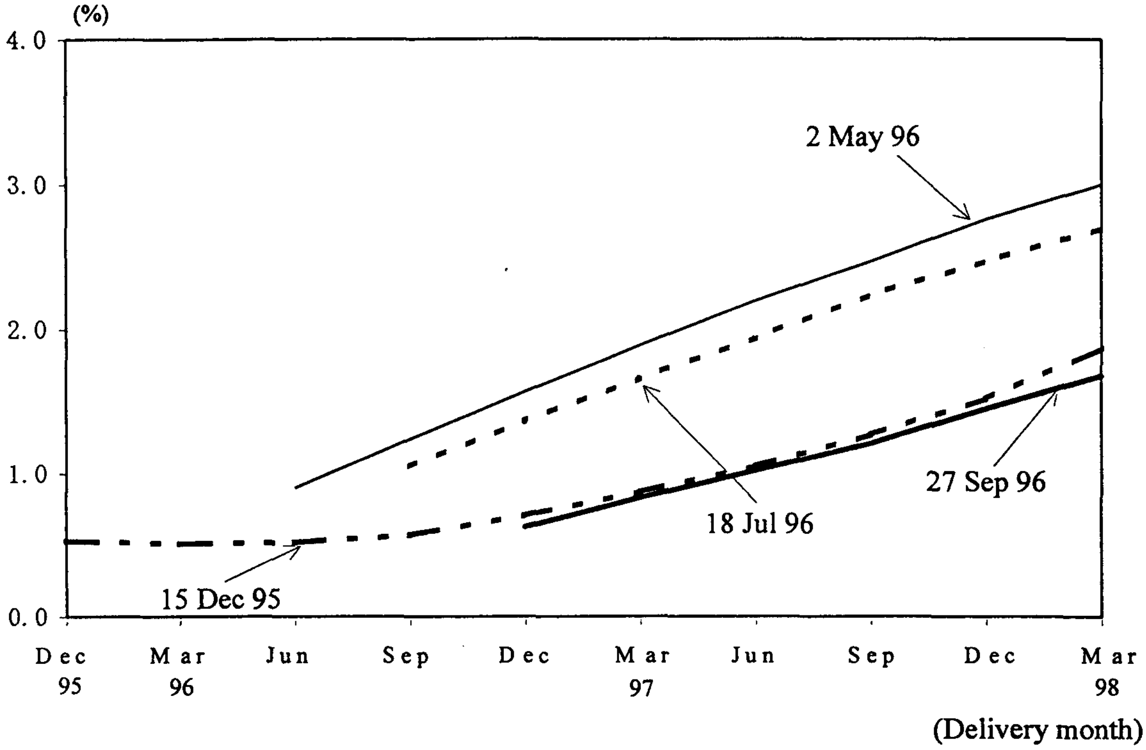
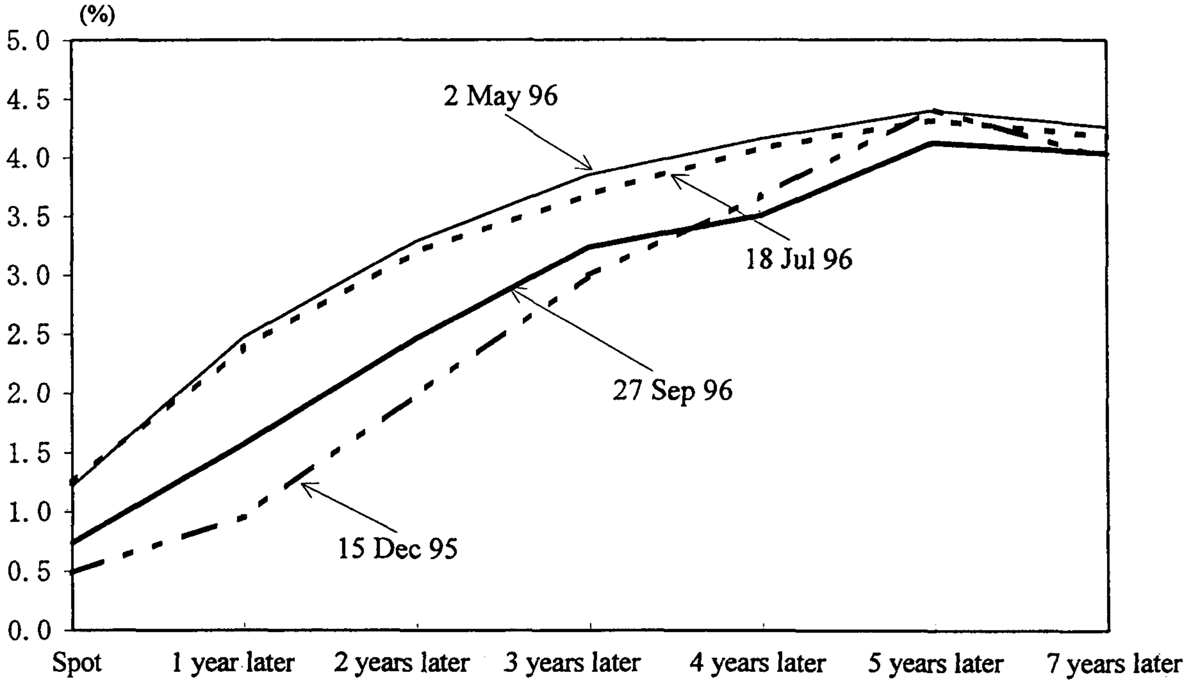
[19] Here, only the analysis of futures and implied forward rates concerning the 1996 case will be made as evidence of this proposition. However, in certain empirical studies, the rise in Japanese long-term interest rates in 1994 has also been found to be mainly attributed to fluctuations in expectations concerning monetary policy rather than to the spill-over from the US long-term rate. See, for example, Borio and McCauley (1995) and Inoue, Ishida and Shirakawa (1995).

Figure 10
Futures and forward rates

Euro-yen Futures (3-month)[1]



Implied Forward Rates[2]



[1] Rates for the corresponding delivery month. [2] One-year forward rates calculated from swap rates.

For example, the development of Euro-yen futures rates (3-month) and implied forward rates (1-year) derived from the yen-yen swaps rate since the beginning of 1996 show that fluctuations in market participants' expectations mainly took place at the relatively short end of the curve, such as rates starting from at most 2 - 3 years later (Figure 10). By contrast, the expected rates (implied forward rates) at the longer end, for example those starting from 5 years later or more, which are thought to be more closely associated with long-term growth or inflation prospects, tended to remain stable. This actually indicates that the rise in long-term interest rates from the beginning of 1996 was mainly caused by fluctuations in market expectations concerning the path of short-term rates, which is most influenced by monetary policy action in the near future.

One reason for this large fluctuation in market participants' expectations concerning future monetary policy is, of course, the increased uncertainty associated with prospects for future economic recovery, which are thought to be the main factor affecting monetary policy. The uncertainty here is not that regarding medium- to long-term growth prospects, but pertains to the timing and speed of recovery in the near future.

It cannot be denied, however, that market participants sometimes reacted wrongly or over-reacted to minor daily changes in the short-term money market rate, causing fluctuations in long-term interest rates. This might have happened because market participants were not yet sufficiently accustomed to the new operating procedure of monetary policy. In addition, since the current level of interest rates is exceptionally low, and hence the possibility that interest rates will go down further is perceived to be very small, market expectations tend to be one-sided (on the upside), which could easily result in excessive expectations of a future rise in short-term interest rates, and hence in an actual excessive rise in long-term rates.

In many industrialised countries, long-term interest rates are also found to be strongly influenced by the fiscal policy stance, which might sometimes reduce the effectiveness of monetary policy: it could occur, for example, that long-term interest rates tend not to fall in line with the easing of monetary policy because of market fears concerning the fiscal deficit. In Japan's case, however, the influence of the fiscal deficit on long-term interest rates has seldom been identified in empirical studies. Thus, at least so far, the fiscal deficit has not been regarded as affecting the effectiveness of monetary policy.

Appendix I

Quantitative measures of monetary policy

In this Appendix, we introduce measures to quantitatively assess the extent of tightness or ease of monetary policy and empirically investigate their usefulness. One measure is called the "Monetary Thrust Index (MTI)", which we are trying to develop, and the other is the Canadian type "Monetary Conditions Index (MCI)". In this paper, however, we have slightly modified the original concept of MCI so as to make it comparable with our MTI. Hence the only difference between two measures here is whether or not to incorporate the impact stemming from changes in the real exchange rate.

1. Monetary Thrust Index (MTI)

1.1 Idea and calculation

The level of nominal interest rates is not necessarily a proper measure of the extent of tightness or ease of monetary policy. For example, an increase in nominal interest rates which falls below the rate of acceleration of inflation would not necessarily have a deflationary impact on real economic activity, since investment decisions, which are naturally thought to be most sensitive to interest rates among various real economic activities, are considered to be based on "real interest rates". If the real expected return on a certain investment is higher than the real interest rate, then that investment is likely to be effected. Thus, whether or not the level of interest rates is thought to be expansionary/deflationary vis-à-vis real activity should be based on a comparison of the real interest rate and the real rate of return on investment.

Based on these considerations, we tried to develop a measure to quantitatively indicate the extent of real tightness or ease of monetary policy, which we call the Monetary Thrust Index (MTI) and define as follows:

MTI = (Nominal policy rate <the overnight call rate>) -
(Expected inflation rate) - (Potential growth rate of GDP)

In the actual calculation of MTI, the *ex post* realised rate of increase in the GDP deflator is used as the expected inflation rate; that is, "perfect foresight" is assumed. For the most recent period where this information is not available, we replace it with our projection of the GDP deflator. The potential growth rate of GDP is used as a proxy for the expected medium-term rate of return on investment. The actual series for the potential growth rate is obtained from our estimation of the production function with certain assumptions. Smoothing of the data series is made for the GDP deflator and potential growth rate by taking the moving average.[20]

1.2 Development of MTI

The actual development of MTI thus calculated is shown in Figure A1, along with the series for each component. From this, we could make certain interpretations of the extent of tightness or ease of monetary policy which are slightly different from those based on nominal interest rates.[21]

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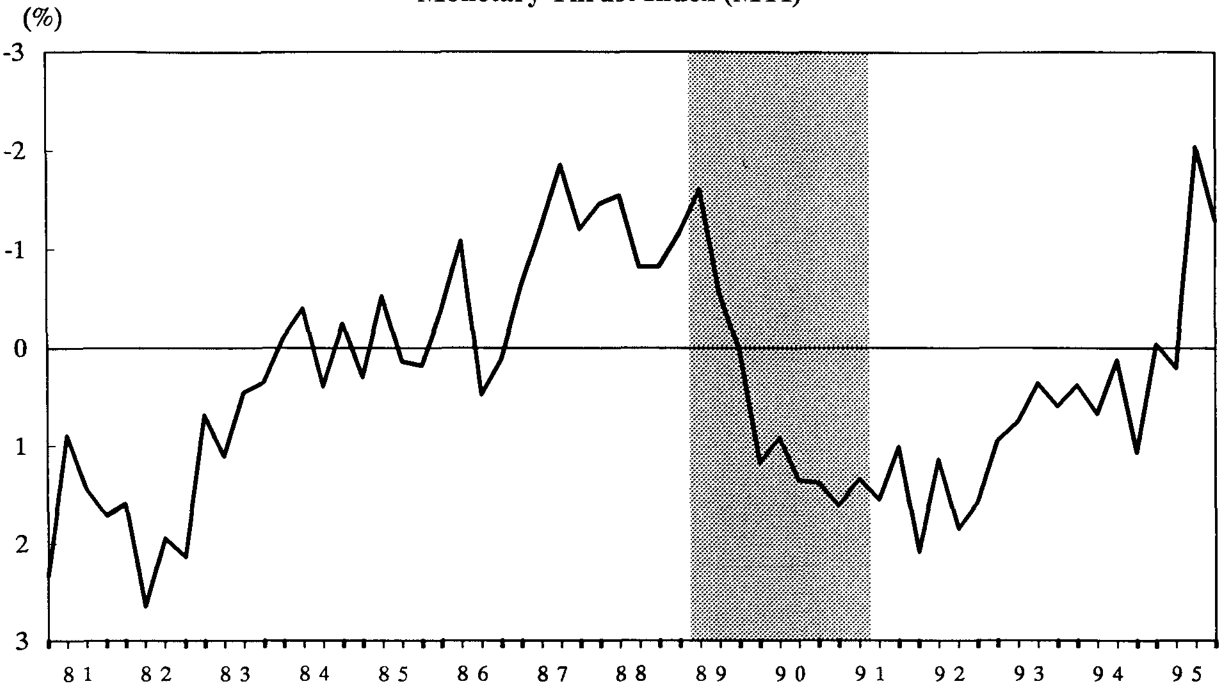
[20] Centred moving averages for three periods (quarters) are actually used.

[21] The reservations stated in the text concerning the interpretation of MTI (notably, a wide range of possibilities for proxying the expected inflation rate and the real rate of return) are also applicable here. Hence the following

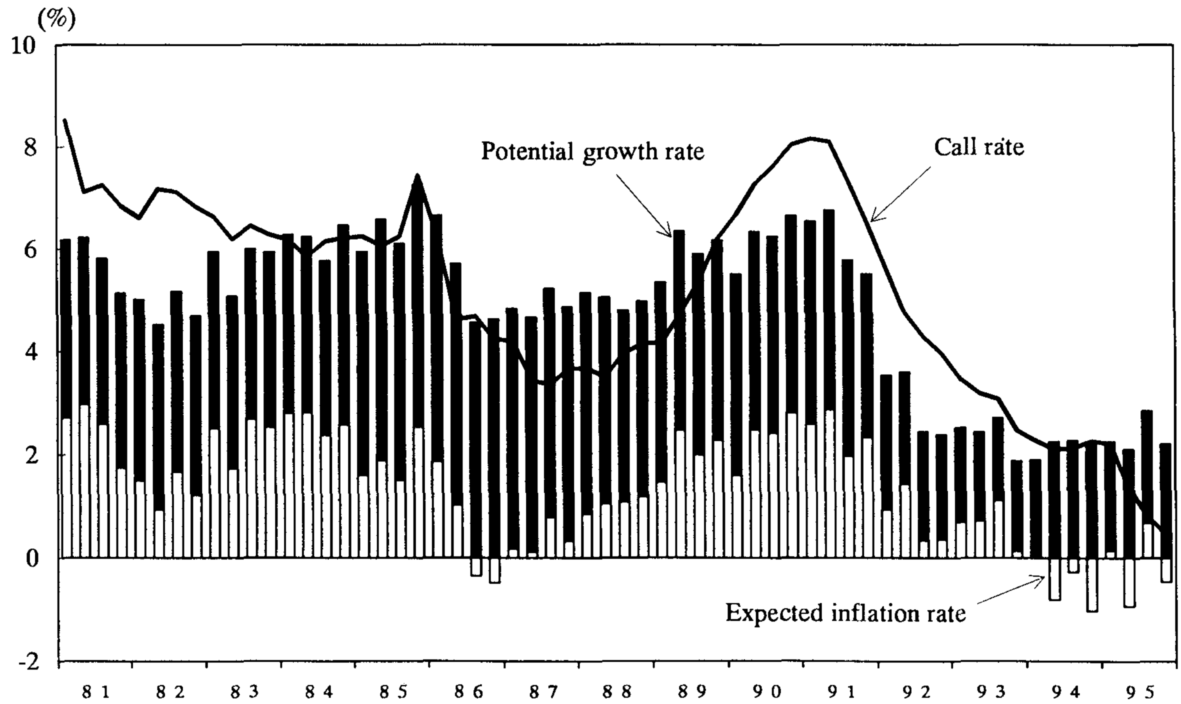
Figure A1

Monetary Thrust Index (MTI)



Notes: MTI = call rate - $((P_{t+2}/P_{t-1})^{4\ 3} -1) \times 100$ - potential growth rate. P = GDP deflator. The shaded area represents monetary tightening period based on official discount rate hike.

Call rate, expected inflation rate and potential growth rate



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interpretations, based on the particular calculation used in this paper, should be taken with suitable allowance for the range of variations of MTI.

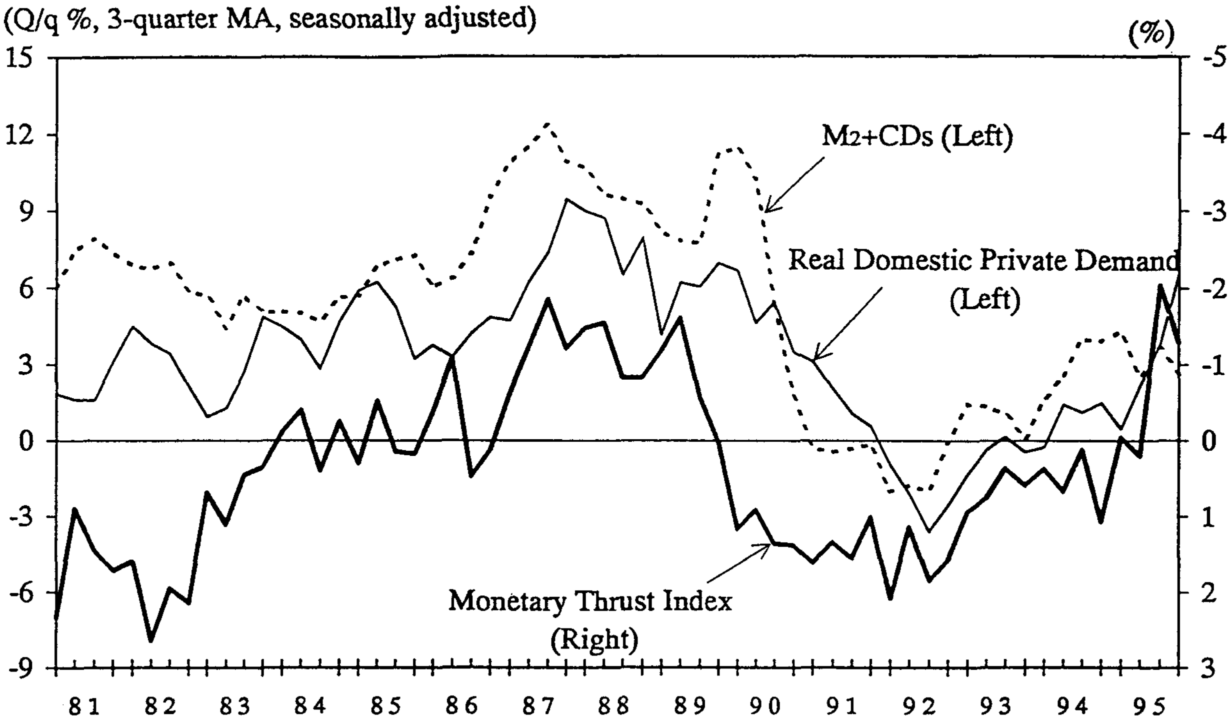
For example:

- since the ODR was gradually lowered, the early 1980s is usually considered a the period of monetary ease. The development of MTI, however, indicates that the actual extent of ease of monetary policy was not as expansionary as suggested by the fall in nominal interest rates alone. In fact, MTI remained positive in the early stage of easing, that is, until around 1983. This was probably because the deceleration of inflation was faster than the fall in nominal interest rates until 1983, since the ODR cuts had been carefully effected so as not to result in further depreciation of the yen;
- although easing of monetary policy started in 1991 and nominal interest rates actually fell quite rapidly, MTI remained positive until around 1994. This suggests that the thrust of monetary policy during this period was not as expansionary as intended, because, in retrospect, the deceleration of inflation and the fall in the potential growth rate were much faster than the reduction of nominal interest rates.

1.3 Usefulness of MTI

To make MTI thus defined and calculated a useful measure of the extent of tightness or ease of monetary policy and the above interpretations plausible, MTI should exhibit a fairly stable relationship with key variables in the policy transmission mechanism. In this light, we empirically checked the relationship between MTI, M2+CDs, and domestic private demand.[22]

Figure A2
Monetary Thrust Index, M2+CDs and real domestic private demand

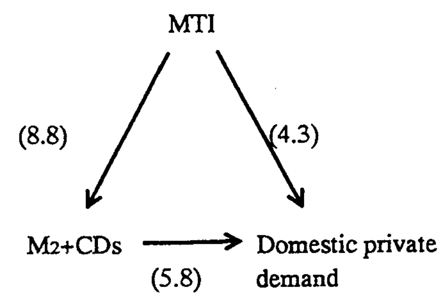


Note: M2+CDs is deflated by the GDP deflator.

[22] M2+CDs is chosen as one of the key variables in the transmission mechanism of monetary policy, because a certain stable relationship with income/price variables has been confirmed in our recent research (see Appendix II). Domestic private demand is chosen as it is the main component of GDP which is directly influenced by monetary policy. External and public demand are thought to be more exogenous and less directly affected by monetary policy.

Figure A3
VAR model estimation results
Sample period: 1st quarter 1981 - 4th quarter 1995

(a) Granger causality

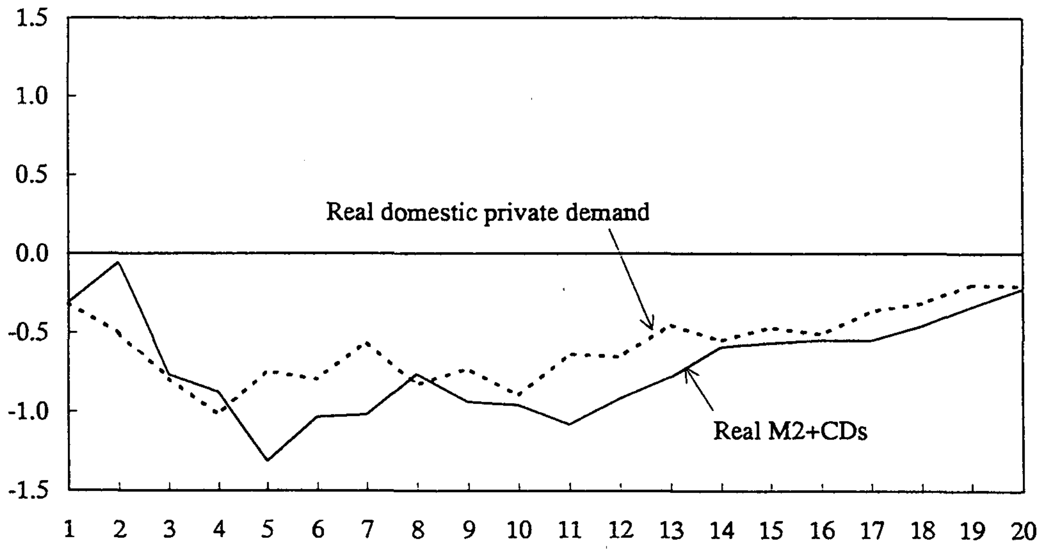


(b) Variance decomposition

LHS variables	RHS variables: MTI	M2+CDs	Domestic Private Demand
MTI	93	3	4
M2+CDs	41	44	15
Domestic Private Demand	53	24	23

Notes: 1. M2+CDs and domestic private demand are changes from previous quarter, 3-quarter moving average, seasonally adjusted.
2. Granger causality test at four quarters (directions of arrows represent lead and lag relationships).
→ 1% significance level,
→ 5% significance level.
3. Figures in parentheses represent F-test values.
4. Variance decomposition at 20-quarter horizon.

Impulse responses (case for 1 standard error MTI shock)



Developments in MTI, real M2+CDs (M2+CDs deflated by the GDP deflator) and real domestic private demand are shown in Figure A2. From this it can be seen that the three variables tend to exhibit similar movements, with MTI maintaining a certain lead over the other two. This can be more formally tested, using a VAR-model of these three variables. The result is shown in Figure A3. The principal findings are as follows:

- MTI causes (in a Granger sense) both M2+CDs and domestic private demand, and M2+CDs also causes domestic private demand;

- variance decomposition result shows that MTI is highly independent, whereas 41% of the variations in M2+CDs is explained by those in MTI. Variations in domestic private demand is substantially explained by both MTI and M2+CDs (53 and 24% respectively).

These empirical results suggest that MTI can actually be regarded as an independent policy variable, affecting the real economic variables through two transmission routes: one by directly influencing private domestic demand, and the other by affecting it via M2+CDs. This can be interpreted as empirically supporting the usefulness of MTI as a quantitative indicator of the extent of tightness or ease of monetary policy.

2. Monetary Conditions Index (MCI)

2.1 Idea of MCI

MCI is a composite index of the short-term interest rate and the foreign exchange rate, and was originally developed by the Bank of Canada. The basic idea can be summarised as follows: There are certain sectors in the economy, such as producers of highly export-oriented goods, which are more directly and sometimes strongly affected by the exchange rate than domestic interest rates. Thus, if the monetary policy stance is assessed only through interest rates, the additional impact of exogenous exchange rate developments directly on these sectors, and also indirectly on the whole economy, could be overlooked and result in the implementation of an inappropriate policy. It is, therefore, more appropriate to look at both interest rates and the exchange rate in order to assess overall "monetary conditions". A composite index, with an appropriate weighting attached to each, would be the most convenient tool for this purpose. MCI is defined as follows:

MCI = (Real short-term interest rate <difference from base period>) + (Fixed weight) *
(Real effective exchange rate <percentage divergence from base period>)

The weighting should be determined by the relative size of the impact of changes in the short-term interest rate and the foreign exchange rate on the real economy, which is usually derived from model estimations.

2.2 Application of MCI to Japan

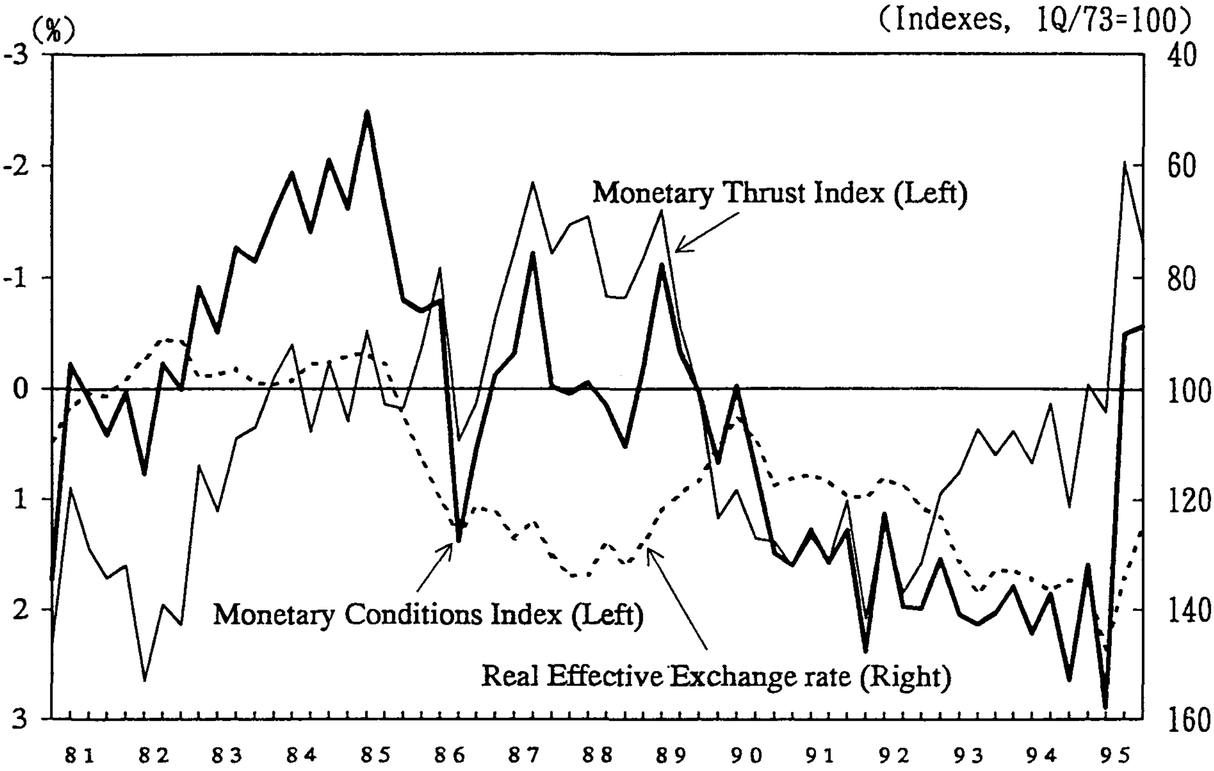
In applying MCI to Japan, we made the following assumptions and modifications:

- the weighting attached to the exchange rate is tentatively assumed to be 1/10, which is much lower than in the Canadian case (1/3), reflecting Japan's lower dependence on the external sector. This weight is based on calculations used by the IMF;
- the divergence of the real short-term interest rate from the base period used in the original MCI formula can theoretically be regarded as a proxy for the divergence of the real interest rate from its equilibrium. This consideration has led us to a slight modification of the formula: that is, in lieu of the divergence from the base period, MTI is used to calculate MCI. This modification has made it possible to directly compare MTI and MCI, the difference between the two being attributed to the exchange rate;
- an export-weighted (rather than trade-weighted) real effective exchange rate is used. This is mainly because, so far in Japan's case, the impact of exchange rate developments on exports through changes in international competitiveness is thought to be far more important.

2.3 Comparison of MTI and MCI, and the usefulness of MCI

MCI thus calculated is compared with MTI in Figure A4. Developments in the real effective exchange rate are also shown for reference. Certain differences between MTI and MCI can be observed: for example, i) monetary conditions from 1983 to 1985 can be regarded as rather expansionary based on MCI (that is, if we take the impact of the depreciation of the yen into account) and ii) monetary conditions in the late 1980s cannot be regarded as expansionary as indicated by MTI, if we take account of the deflationary impact of the appreciation of the yen during this period. These differences between MTI and MCI are, of course, caused by developments in the real effective exchange rate.

Figure A4
Monetary Conditions Index and Monetary Thrust Index

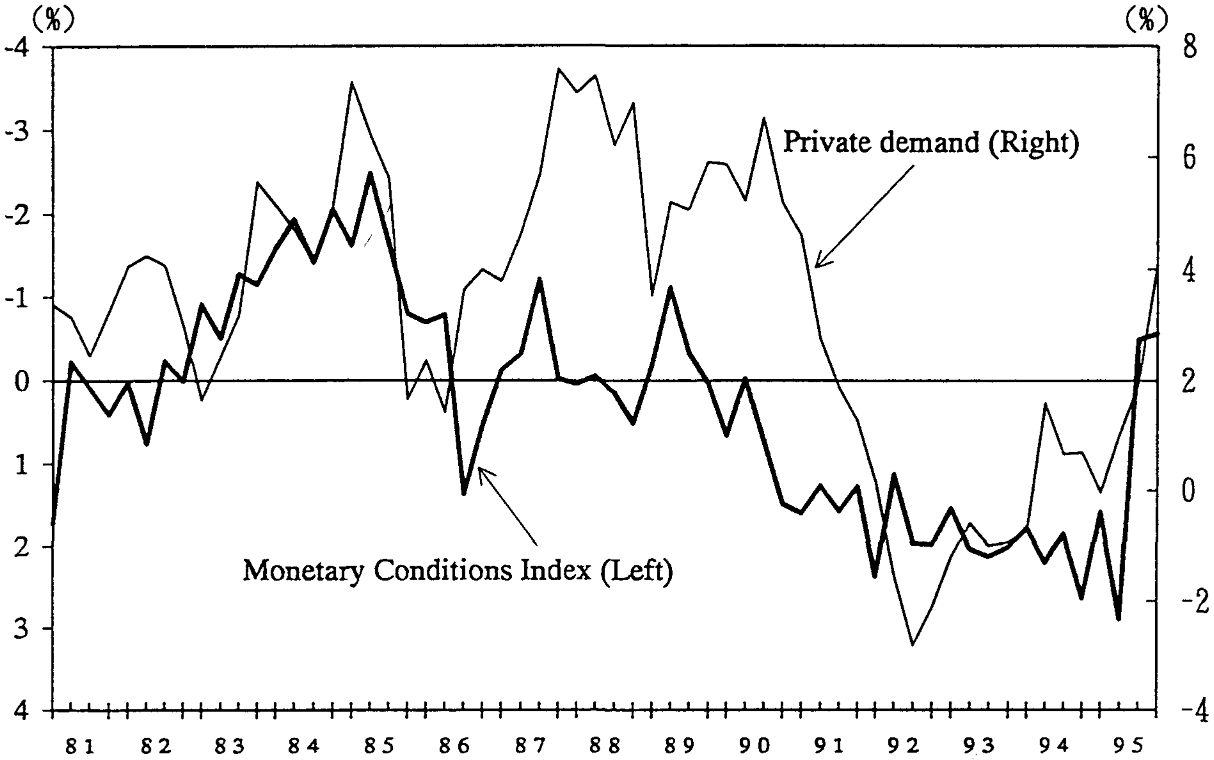


Note: MCI = real effective exchange rate (% change from base period, 4th quarter 1989) *0.1 + Monetary Thrust Index.

Reflecting this difference, MCI is theoretically thought to be more closely correlated with "domestic private demand + net exports" (denoted as "private demand" hereafter), whereas MTI is found to have a close relationship with domestic private demand, as already discussed. However, the close relationship between MCI and private demand has not been confirmed empirically:

- a comparison of both series in Figure A5 fail to prove the existence of a close relationship;
- causality (in a Granger sense) from MCI to private demand seems to be much weaker compared with that from MTI to private domestic demand: i) no direct causality exists from MCI to private demand, and ii) although causality from MCI to private demand through M2+CDs has been found to be significant, the first part of this causality (MCI→ M2+CDs) seems to be weaker (see the F-ratio in Figure A6);

Figure A5
Monetary Conditions Index and private demand



Notes: MCI = real effective exchange rate (% change from base period, 4th quarter 1989) *0.1 + Monetary Thrust Index. Real private demand = real domestic private demand + net exports.

- only 44% of the variations in private demand is explained by those in MCI, compared with 51% in the case of domestic private demand and MTI.

These empirical findings might imply that the usefulness of MCI thus calculated is less significant compared with MTI.[23]

Thus, even if the proposition that monetary policy should be conducted in such a way as to fully offset the impact of the change in the exchange rate is accepted, we should still be very careful in using MCI as an indicator for such policy implementation.

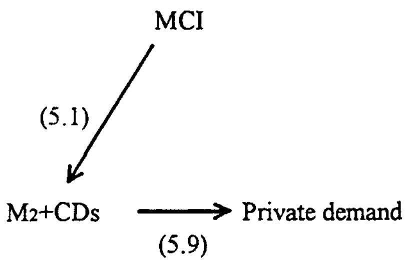
[23] This might be because of the method used in calculating MCI; that is, the appropriateness of the weighting given to the interest rate and the exchange rate. A weighting of 1/10 is tentatively used, but there could be other possibilities. For example, the multiplier derived from the BOJ-model suggests 1/5. We did not use this because it would further widen the difference between MTI and MCI, and, in fact, indicate that monetary conditions were even tight in the late 1980s, which is far from being realistic. A fixed weighting might also be inappropriate, as the impact of the exchange rate on net exports can change over time, owing, for example, to exporters moving production abroad.

Figure A6

VAR model estimation results

Sample period: 1st quarter 1981 - 4th quarter 1995

(a) Granger causality

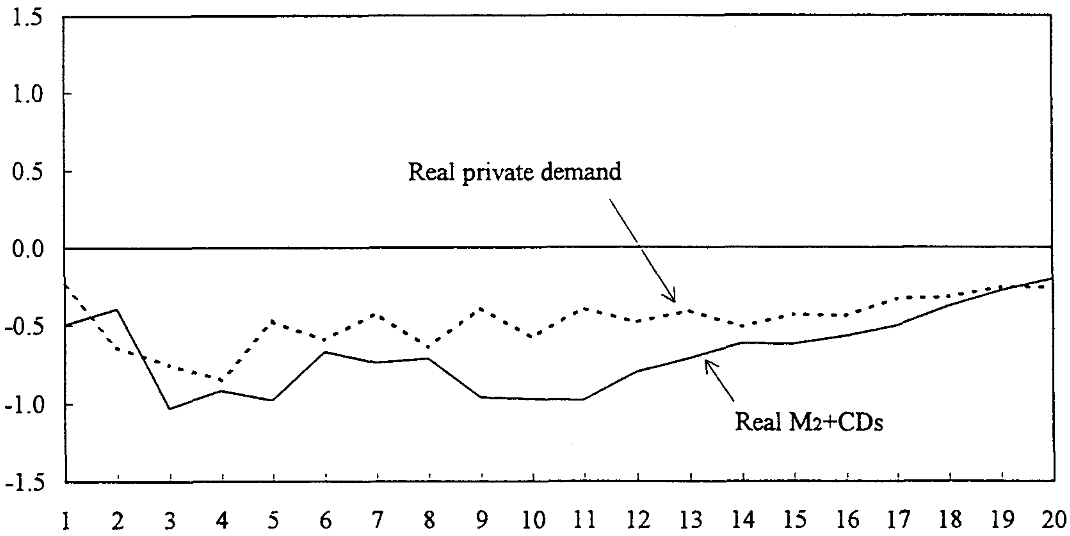


(b) Variance decomposition

	RHS variables		
LHS variables	MCI	M2+CDs	Private demand
MCI	94	3	3
M2+CDs	37	42	21
Private demand	44	25	31

Notes: 1. M2+CDs and domestic private demand are changes from previous quarter, 3-quarter moving average, seasonally adjusted.
2. Granger causality test at four quarters (directions of arrows represent lead and lag relationships).
⟶ 1% significance level,
⟶ 5% significance level.
3. Figures in parentheses represent F-test values.
4. Variance decomposition at 20-quarter horizon.

Impulse responses (case for 1 standard error MCI shock)



Appendix II

Relationship between M2+CDs and price/income variables; main results of empirical analyses

In this Appendix, we summarise the main results obtained from our recent empirical studies concerning the relationship between M2+CDs and price/income variables. The studies are concerned with three aspects: i) the existence of a long-run equilibrium relationship (co-integration) between M2+CDs, price and income; ii) the stability of the money demand function; and iii) the precedence of money to price/income variables.

1. Long-run equilibrium relationship between M2+CDs and price/income

In recent empirical studies, it is quite common to test the long-run relationship by estimating the co-integrating vector. Before applying this method to M2+CDs and price/income variables (respectively the GDP deflator and real GDP), the non-stationarity of each variable has been checked using the ADF test, and each has, in fact, been found to be non-stationary. Then, the co-integrating vector among these three variables was estimated using the Canonical Co-integrating Regression method.[24]

Table A1

Cointegration between M2+CDs and real GDP[1]

Long-term elasticity with real M2+CDs as the dependent variable[2]

Sample period	Independent variables		Results of ADF test on cointegration[3]
	Real GDP	Shift dummy (1986 Q1)	
1967 Q2 - 1985 Q4	1.526 (0.036)	–	Cointegrated
1967 Q2 - 1996 Q1	1.594 (0.020)	–	Cointegrated
1967 Q2 - 1996 Q1	1.526 (0.029)	0.046 (0.023)	Cointegrated

[1] Figures in parentheses represent standard errors. [2] Real M2+CDs represents seasonally adjusted M2+CDs deflated by the GDP deflator. [3] The ADF (Augmented Dickey-Fuller) test, tests the characteristic of a time series. In this test, "cointegrated" indicates rejection of the hypothesis that "a series of residuals is non-stationary" with a significance level of 5%. In other words, the residuals form a stationary process and the dependent and independent variants are cointegrated.

The results are shown in Table A1. The actual estimation of the co-integrating vector was made between real M2+CDs (M2+CDs divided by the GDP deflator) and real GDP, by assuming the long-term neutrality of money; that is, the long-run elasticity of M2+CDs to the price level (GDP deflator) is assumed to be unity. The result shows that, if we make an adjustment for the small structural changes that are supposed to have occurred in the late 1980s (by introducing a level-shift dummy variable),[25] there exists a long-run equilibrium relationship between real M2+CDs and real GDP, and the long-run income elasticity of money is close to 1.5.

[24] For details, see Park (1992),

[25] This structural change in the late 1980s is thought to have been caused by the diminished opportunity cost of holding M2+CDs following the deregulation of deposit interest rates.

2. Stability of the money demand function

The existence of a co-integrating vector between M2+CDs and GDP just implies that the divergence between them would tend to stay in a certain range in the very long run. Since a considerable divergence could actually emerge in the short-run and last for a period of time, the long-run equilibrium relationship alone might not be sufficient for monetary aggregates to be useful in the implementation of monetary policy. In this light, we estimated a short-run money demand function, and tested its stability.

Table A2

Estimated results of the money demand equation

Explanatory variables	**Sub-sample**	**Full sample**
$\Delta(m-p)_{t-1}$	0.428 (3.6)	0.405 (4.7)
ETC_{t-1}	-0.057 (-1.7)	-0.056 (-2.3)
Δy_t	0.391 (3.2)	0.338 (3.6)
$\Delta R_t'$	-0.013 (-1.6)	-0.018 (-3.0)
ΔW	0.172 (3.5)	0.089 (2.5)
$\Delta tika$	0.112 (1.9)	0.125 (4.1)
Constant	-0.455 (-1.9)	-0.441 (-2.3)
$\bar{R}^2$	0.70	0.69
S.E.	0.009	0.008
Durbin's h	-1.46	1.02

Notes:

1. Dependent variable: $\Delta(m-p)_t$

   where *m*: M2+CDs (nominal); *y*: real GDP; *p*: GDP deflator.

   R: opportunity cost of holding money (%) = "rival rate" [average of bonds with repurchase agreements (3-month), medium-term government bond funds, MMFs (money market funds), postal savings certificates (3-year), loan trusts (5-year), money in trust (5-year), and yield to subscribers of interest-bearing bank debentures (5-year)] minus rate of return on holding M2+CDs.

   $R_t' = 6/21 * R_{t-1} + 5/21 * R_{t-2} + 4/21 * R_{t-3} + 3/21 * R_{t-4} + 2/21 * R_{t-5} + 1/21 * R_{t-6}$.

   W: outstanding financial assets of corporate business and personal sector, based on Flow of Funds Accounts.

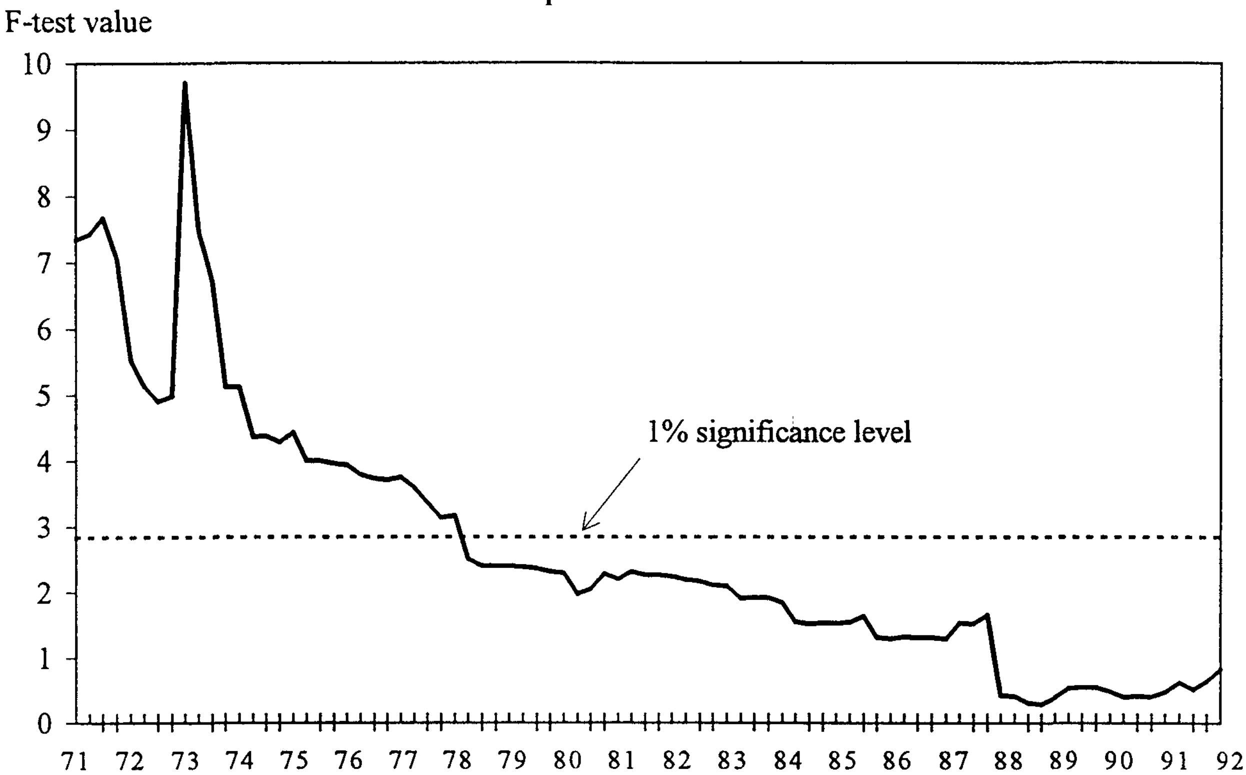
   tika: land prices, based on Urban Land Price Index (average of residential and commercial land prices in the six major cities: 23 wards of Tokyo, and Yokohama, Nagoya, Kyoto, Osaka and Kobe).

   m, *y* and *p* are seasonally adjusted and are represented as logarithms.

   Figures in parentheses are t-values, Δ indicates difference from previous period.
2. *ETC* ("error correction term" based on long-term equilibrium): $m-p-1.5y$; see Table A1.

An ECM (error correction model) money demand function was estimated. This model is able to describe the short-run adjustment process among various (stationary) variables that affect demand for money and fully incorporate the long-run equilibrium relationship between level of money and income. The estimation result is shown in Table A2. By comparing the result for the "full-sample" (1968 1Q - 1996 1Q) and "sub-sample" (1968 1Q - 1985 4Q) periods, it can be seen that,

Figure A7
Stepwise Chow test



although small changes in individual parameters are observed, the same functional structure applies reasonably well to both periods, and the magnitude of change in the parameters is mostly within estimated standard errors. This suggests that the same short-run money demand function exists for the whole period, and that no major structural changes took place in the late 1980s as is usually argued. The Chow test result also seems to confirm the stability of the money demand function during the 1980s (Figure A7).[26]

3. Precedence of money to income/price variables

The money demand function estimated above is in fact a single equation which simply explains the development of M2+CDs when all explanatory variables are given exogenously, and does not incorporate any dynamic interdependence of the variables (for example, GDP could be possibly affected by current and past M2+CDs). Instead of trying to model the whole dynamic system, which might involve various empirical difficulties, we try an approximation using a VAR system which includes only key variables. Before estimating a VAR model, we first checked the lead/lag relationship between money and income/price variables by lagged correlation coefficients.

3.1 Lagged correlation between M2+CDs and income/price variables

3.1.1 Correlation between M2+CDs and GDP, domestic private demand (Table A3-1)

M2+CDs precedes both nominal and real GDP for the last calculation period (1986 1Q - 1996 1Q), with a lead of two to three quarters. The lead of M2+CDs to GDP, however, is not found

[26] The possibility of a structural break in the function is suggested in the early 1970s, which would be attributable to the oil shock. However, no break has been identified after that, including the late 1980s.

during 1977 1Q - 1985 4Q. Although this is probably because the relationship is more difficult to identify statistically due to the very small variations in M2+CDs during this period, there might be some doubt that M2+CDs consistently exhibits precedence to GDP.

In the monetary transmission mechanism, monetary aggregates are expected to affect, in the first place, private domestic demand rather than total GDP, as explained in Appendix I. In fact, the precedence of M2+CDs to private domestic demand seems to be more stable than in the case of GDP.

Table A3

Lagged correlation between M2+CDs and economic indicators[1]

1. GDP, domestic private demand

	1968 1Q - 1976 4Q	**1977 1Q - 1985 4Q**	**1986 1Q - 1996 1Q**
Nominal GDP[2]	0.70 (-5)	0.90 (+4)	0.90 (-4)
Real GDP[2]	0.46 (0)	0.77 (+2)	0.89 (-2)
Nominal domestic private demand	0.69 (-4)	0.80 (-1)	0.92 (-2)
Real domestic private demand	0.49 (-1)	0.52 (+1)	0.91 (-1)

2. Inflation indicators

	1968 1Q - 1976 4Q	**1977 1Q - 1985 4Q**	**1986 1Q - 1996 1Q**
GDP deflator[2]	0.79 (-6)	0.83 (+5)	0.85 (-8)
WPI[2,3]	0.76 (-6)	0.69 (-5)	0.70 (-7)
CPI[2,4]	0.73 (-7)	0.78 (-6)	0.73 (-8)

3. Asset prices

	1968 1Q - 1976 4Q	**1977 1Q - 1985 4Q**	**1986 1Q - 1996 1Q**
Stock prices[2,5]	0.79 (0)	-0.04 (+4)	0.73 (+4)
Land prices[2,6]	0.88 (0)	0.13 (+1)	0.98 (+3)

[1] Figures indicate the largest negative cross-correlation coefficient within the eight periods before and after the period concerned. Figures in parentheses are time lags and negative figures represent the lead of M2+CDs. [2] Based on annual changes in quarterly data. [3] Average of overall domestic wholesale prices. [4] Overall consumer prices. [5] Based on Tokyo Stock Price Index (TOPIX). [6] Based on Urban Land Price Index (average of residential and commercial land prices in the six major cities: 23 wards of Tokyo, and Yokohama, Nagoya, Kyoto, Osaka and Kobe).

Sources: Bank of Japan, *Economic Statistics Monthly*; Management and Coordination Agency, *Consumer Price Index*; Tokyo Stock Exchange, *Monthly Statistics Report*; Japan Real Estate Institute, *Urban Land Price Index*.

3.1.2 Correlation between M2+CDs and price variables (Table A3-2)

In most case, M2+CDs precede price variables, with a longer lag (five to eight quarters) than in the case of GDP. This observation seems to be consistent with the view that, although short-term changes in monetary aggregates could cause those in real variables such as real GDP, they would only change prices in the long term.

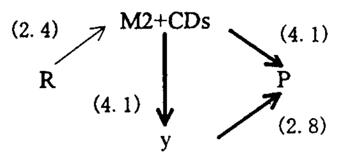
Figure A8

VAR model estimation results

(1) Variables: R (call rate), M_2+CDs, y (real GDP), P (GDP deflator)

① Sample period: 2Q/67-4Q/85

(a) Granger Causality

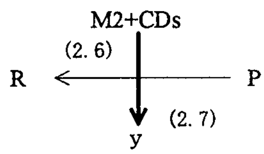


(b) Variance Decomposition

	RHS variables			
LHS variables	R	M2+CDs	y	P
R	71	19	2	7
M2+CDs	10	88	1	1
y	8	28	62	2
P	12	49	7	31

② Sample period: 2Q/86-1Q/96

(a) Granger Causality



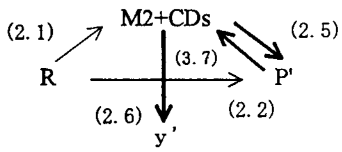
(b) Variance Decomposition

	RHS variables			
LHS variables	R	M2+CDs	y	P
R	46	25	6	13
M2+CDs	30	54	4	12
y	17	29	36	18
P	23	10	10	57

(2) Variables: R (call rate), M2+CDs, y' (real domestic private demand),
P' (domestic private demand deflator)

① Sample period: 2Q/67-4Q/85

(a) Granger Causality

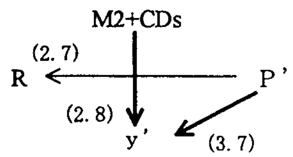


(b) Variance Decomposition

	RHS variables			
LHS variables	R	M2+CDs	y'	P'
R	53	15	9	23
M2+CDs	10	70	2	18
y'	4	18	60	18
P'	10	28	5	57

② Sample period: 2Q/86-1Q/96

(a) Granger Causality



(b) Variance Decomposition

	RHS variables			
LHS variables	R	M2+CDs	y'	P'
R	21	42	1	36
M2+CDs	10	72	1	17
y'	12	31	28	29
P'	12	7	17	64

Notes: 1. y, y', P P' are changes from previous period.
2. Granger causality test at four quarters (directions of arrows represent lead and lag relationships).
→ 5% significance level,
→ 10% significance level.
3. Figures in parentheses represent F-test values.
4. Variance decomposition at 20-quarter horizon.

3.2 Estimation of the VAR model

Given the observation of the lagged correlation coefficients in (1), two VAR models, both of which consist of four variables, are estimated: i) one including M2+CDs, real GDP, the GDP deflator and the overnight call rate, and ii) a second one with M2+CDs, real domestic private demand, the domestic private demand deflator and the call rate. In each, estimations are made for two different periods, namely, 1967 2Q - 1985 4Q and 1986 2Q - 1996 1Q, to see if any change can be observed after the mid-1980s.

The results are shown in Figure A8. Causality (in a Granger sense) from M2+CDs to income variables is found to be significant in all cases. Contrary to the observations of lagged correlation coefficients, no major difference can be seen between GDP and domestic private demand. As regards price variables, the most embarrassing results would be that, in either case, causality from M2+CDs to the deflator is not significant after the mid-1980s. This might be because the lag of the VAR model (four periods in each model) is too short compared with the rather long lag from M2+CDs to price variables indicated by the lagged correlation coefficients.

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Monetary tactics with an inflation target: the Swedish case

Hans Lindberg, Kerstin Mitlid and Peter Sellin[1]

Introduction

In November 1992, the Riksbank was forced to abandon the fixed exchange rate regime. The ultimate objective of monetary policy remained price stability, but the decision to let the Krona float involved a change in the overall strategy of monetary policy for achieving this ultimate objective. The Riksbank decided against replacing the fixed exchange rate with some other kind of intermediate target, such as a money supply target. In January 1993 the Governing Board of the Riksbank adopted an explicit inflation target by stating that the monetary policy target is to "limit the annual increase in the consumer price index in 1995 and onwards to 2%, with a degree of tolerance of ±1%." In 1993 and 1994, that is, before the target became operative, monetary policy was to be directed towards preventing the underlying rate of inflation from rising.

The framework within which monetary policy is conducted in Sweden contains four distinct elements: the instruments under the direct control of the Riksbank (the portfolio and the terms of credit facilities); the operational target upon which the instrument changes operate (short-term market rates or monetary conditions); the Riksbank's inflation forecast; and the inflation target. The transmission mechanisms through which monetary policy influences the inflation rate is crucial within this framework. The transmission mechanisms of monetary policy includes interest rate effects, exchange rate effects, other asset price effects and the so-called credit channel. Monetary policy influences the inflation rate with a considerable time lag. The full effects on demand and inflation on average take about 1-2 years to show up. This implies that the Riksbank must base monetary policy on an assessment of the future inflation rate. The Riksbank works with a broad spectrum of indicators for future inflation. However, the main factors for future inflation are the current and future states of supply and demand, the expectations about future inflation and exchange rate movements. The inflation forecast is made conditional on the current state of the instruments and all other information considered relevant. The next step is to pin down a path for the instruments believed to put developments of monetary conditions (essentially, the weighted sum of real interest rates and the real exchange rate) so that the inflation forecast equals the target over a horizon of 1-2 years. The actual inflation rate will of course differ from the target, because of forecast and control errors. However, if the policy is successful, the mean deviation from target will be zero, and the variance of deviations minimised.[2]

Monetary tactics concern the first step of the transmission mechanism, that is, the central bank's interaction with the financial markets. Monetary tactics include, for instance, the choice of instruments for implementing monetary policy, how the instruments are used to reach operational targets, and the principles for the central bank's communication with the markets, including the attitude towards information disclosure and transparency. This paper takes a Swedish perspective on some of these issues. Section 1 explains the current system of interest rate policy instruments, which was introduced in 1994 partly as a response to the move to a flexible exchange rate. The tactics of policy rate adjustments and the need for transparency and information disclosure with an explicit inflation target are discussed in Section 2. Section 3 examines the influence of monetary policy

1 We are grateful to Claes Berg and Hans Dillén for helpful comments. The views in this paper are those of the authors and do not necessarily reflect those of the Sveriges Riksbank.

2 See Svensson (1996) for an excellent discussion of inflation targeting.

announcements by estimating the effects of speeches, inflation reports and changes in the instrumental rates on market interest rates. The final section summarises the discussion and our conclusions.

2 Monetary instruments

A new system for the practical management of monetary policy was introduced in June 1994. In the earlier system, the interest rates on lending and deposit facilities took the form of an ascending scale, whereby the marginal cost of a bank's borrowing from the Riksbank rose with the amounts borrowed. The highest step at which a bank borrowed was known as the marginal rate. The Riksbank determined the level of the marginal rate by managing liquidity so as to bring net borrowing by the banking system up to the desired step on the scale. The transition to a flexible exchange rate in November 1992 and the introduction of the inflation target altered the requirements for monetary policy signalling. Interest adjustments of 0.25 percentage points, which were the smallest adjustments the interest rate scale permitted, seemed unduly large with a more gradual approach to interest rate management. Another disadvantage of the system was the complete focus on the marginal rate, which limited flexibility and implied that the Riksbank only had one policy rate for signalling.

The new system provides one deposit and one lending facility. The deposit rate (i_0) and the lending rate (i_1) are set by the Governing Board of the Riksbank and form a corridor within which the repo rate – the Riksbank's primary instrumental rate – is set by the Governor in accordance with monetary policy guidelines established by the Governing Board (see Figure 1). The interest rate corridor provides the Riksbank with a tool for signalling its long term intentions concerning the repo rate (see Figure 2). This kind of signalling became more important after the introduction of the inflation target.

The repo rate is the rate at which, as a means of managing the liquidity of the banking system, securities with a maturity of one week are bought or sold by the Riksbank under a repurchase agreement. The repo rate may be interpreted as the Riksbank's target for the level of the overnight rate (i) in the interbank market. Repos or reversed repos are placed by tender every Tuesday. The repo rate is either fixed and determined by the Riksbank, or variable and set by tender. A fixed repo rate constitutes a considerably clearer signal to the market and provides a distinct indication of the desired direction of interest movements. Repos are normally offered at a fixed rate, leaving the Riksbank's counterparties to tender the volumes they are interested in depositing or borrowing for one week at that rate.

Figure 1
The interest rate corridor

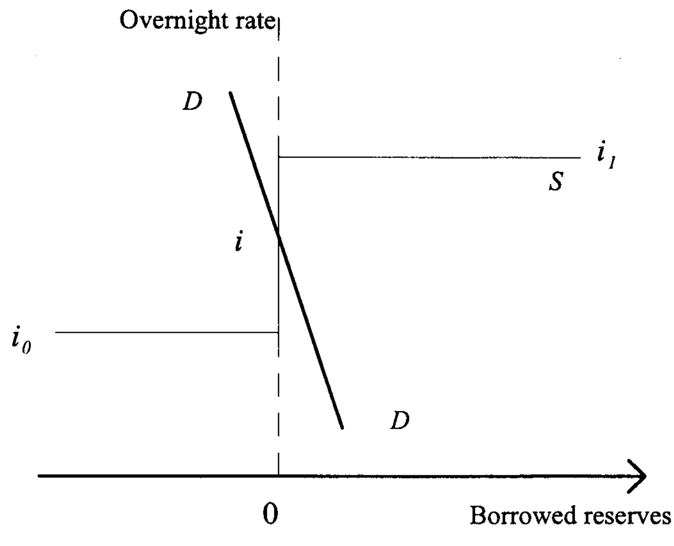
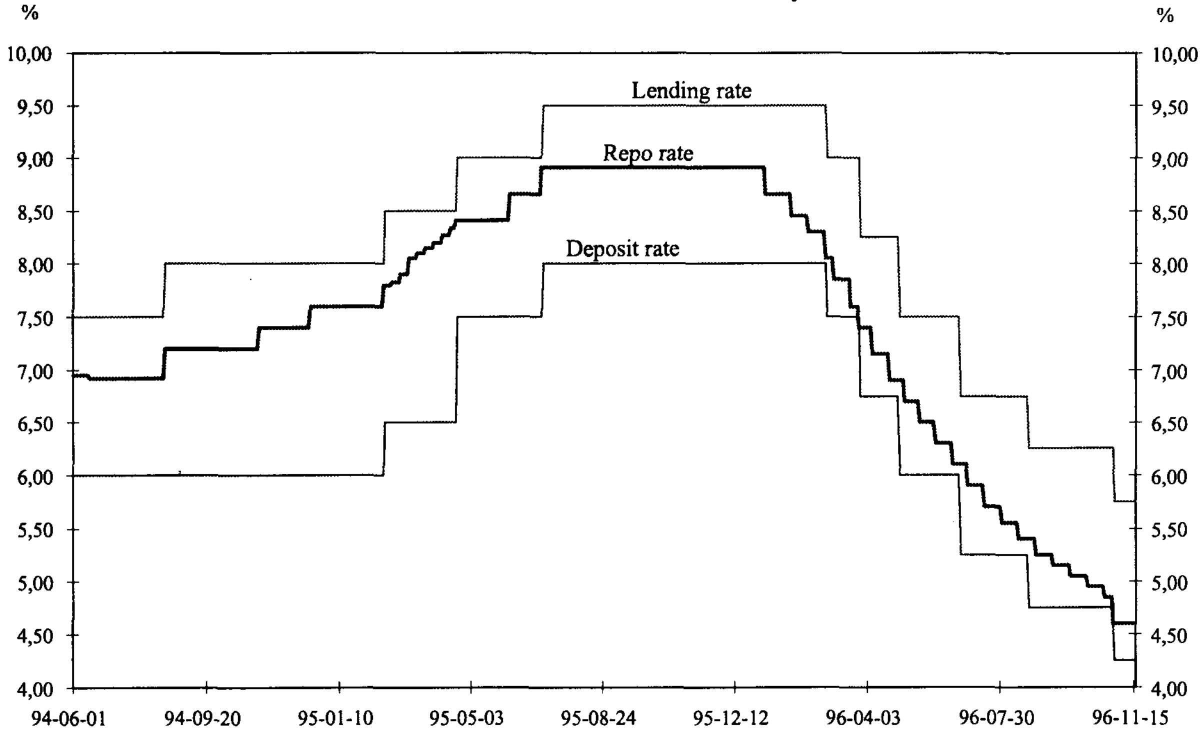


Figure 2

The instrumental rates in the new system



In recent years the Swedish banking system has had an underlying surplus liquidity. To withdraw this surplus, the Riksbank has employed reversed repos; instruments known as Riksbank's certificates are also offered to drain the liquidity (see Table 1).

Table 1

The Riksbank's balance sheet, end of October 1996

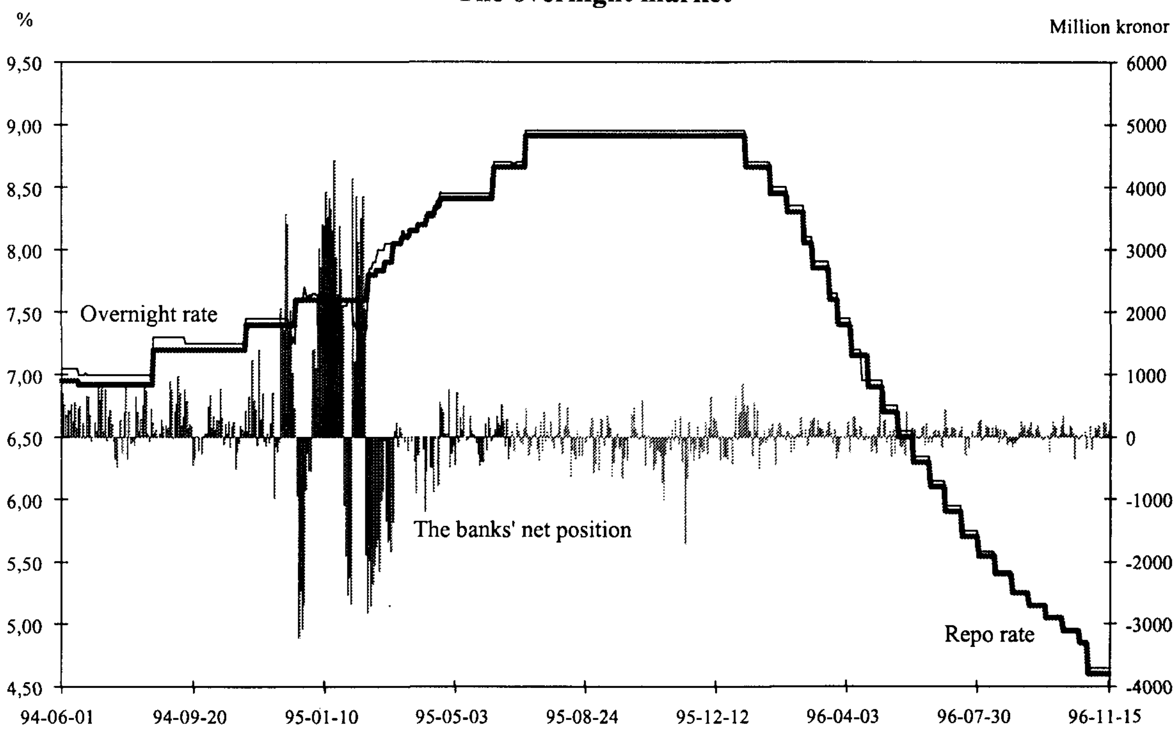
In billions of Swedish kronor

Assets		**Liabilities**	
Foreign reserves	149	Notes and coins	72
Securities..................................	62	Standing facilities	0
		Riksbank's certificates...............	59
		Others	80
Total assets...............................	211	Total liabilities...........................	211

The demand for borrowed reserves (the net position of the banking system in the central bank's deposit and lending facilities) is, in practice, entirely determined by the Riksbank's liquidity management (the supply of non-borrowed reserves). As the reserve requirement is zero, the banking system has only two alternatives during the repo period: to use the Riksbank's facilities to deposit/borrow any liquidity surplus/deficit or adjust its demand for bank notes. Since demand for bank notes is insensitive to interest rates in the short run, the interest rate elasticity of demand for reserves is low. Hence, an unexpected shift in the demand for borrowed reserves may have a strong impact on the overnight rate; see the episodes during 1994 and 1995 in Figure 3.

If financial markets function efficiently and risk premia are stable, the longer market rates are mainly determined by the expected overnight rate for the period in question. To make monetary policy's impact on the somewhat longer market rates as distinct as possible, there needs to be a strong

Figure 3
The overnight market



link between the repo rate and the overnight rate, at least in terms of the average for the period. To ensure this, in the past year the Riksbank has chosen to stabilise the overnight rate at the level of the repo rate by fine tuning liquidity so that the supply of borrowed reserves is very close to zero.[3] There are few participants in the overnight market and their liquidity positions can be followed on a continuos basis, which makes the fine tuning easy to implement. The fine tuning implies that the banking system as a whole encounters a marginal net borrowing cost that equals the repo rate, with the result that the overnight rate is established at the same level.

2 Tactics for key rate changes

2.1 Theoretical models of changes in the key rate

It is not unusual to see models of central bank behaviour that include the volatility of the nominal interest rate in the bank's objective function (a recent example is Söderlind (1996)). In such a model the central bank chooses the short-term interest rate, i, so as to minimise an objective function of the form:

$$E_t \sum_{t=0}^{\infty} \beta^t \left(q_y y_t^2 + \left(1 - q_y\right) \pi_t^2 + q_i i_t^2 \right),$$

subject to some conditions, where β is a discount factor, y is deviations of log output from trend, π_t is the inflation rate, q_y is the weight on output relative to inflation volatility, and q_i is the weight on volatility in the nominal interest rate. One clearly realises that in such a model there will be a high

[3] In order to provide an incentive to use the weekly repos, the rate for fine tuning is actually somewhat inferior to the repo rate.

degree of persistence in nominal interest rates. For example, Söderlind (1996) estimates the optimal simple rule:

$$i_t = 0.04y_t + 0.06\pi_t + 0.97i_{t-1}$$

for quarterly US data from 1Q 1960 to 2Q 1994. The 3-month T-bill rate is then assumed to be equal to the theoretical policy instrument, i , plus a normally i.i.d. error term. Hence, the 3-month rate is close to a random walk. This analysis is also in line with Mankiw and Miron (1986), who argue that the Fed's policy of stabilising short-term rates is the reason why some researchers have found close to a random-walk behaviour in short rates.

However, there is no general agreement in the literature as to *why* the central bank would impart a high degree of persistence to nominal interest rates. In Cukierman (1989) the central bank smoothes interest rates so as to cushion against interest rate shocks that could lead to widespread insolvencies in the banking system. Mankiw (1987) explains interest rate smoothing as optimal inflation tax smoothing. The expected dead-weight loss due to a distortionary inflation tax is minimised by maintaining expected constancy in the nominal interest rate.

Goodfriend (1991) finds these two explanations unsatisfying and offers an alternative explanation. He suggests that the routine pursuit of macroeconomic stabilisation policy might induce the central bank to smooth interest rates. The rationale for this is the following. Output and prices respond to changes in longer-term rates and not to changes in the key rate directly. Longer-term rates are determined as an average of expected future key rates. In order to be able to influence expectations about future key rates the central bank has to communicate its policy intentions very clearly. The easiest way to do this is to maintain an expected constancy in the key rate. The key rate is therefore changed infrequently and in relatively small steps.[4]

Models with key rates that change infrequently in discrete steps have recently been proposed by Balduzzi, Bertola and Foresi (1993), Dotsey and Otrok (1995), Rudebusch (1995), and El-Jahel, Lindberg and Perraudin (1996). The first three papers can be said to be attempts to formalise the analysis in Mankiw and Miron (1986) referred to above. In a realistic model of noisy targeting and infrequent target changes, Balduzzi, Bertola and Foresi (1993) show how expectations of future policy actions introduce persistent spreads between interest rates of different maturities. Dotsey and Otrok (1995) and Rudebusch (1995) both construct a model of the term structure coupled with a model of monetary policy. The Fed is assumed to adjust its funds rate target infrequently and in relatively small steps. Term structure tests on simulated data from the models are able to reproduce the empirical results reported in the literature. These results are thus consistent with rational expectations. El-Jahel, Lindberg and Perraudin (1996a) supply analytical solutions for interest rate densities and bond prices under the assumption that short rates follow a pure jump process of which the rate of jump is a function of an Ornstein-Uhlenbeck process. This modelling approach is implemented in El-Jahel, Lindberg and Perraudin (1996b).

2.2 The Riksbank's tactics for key rate changes

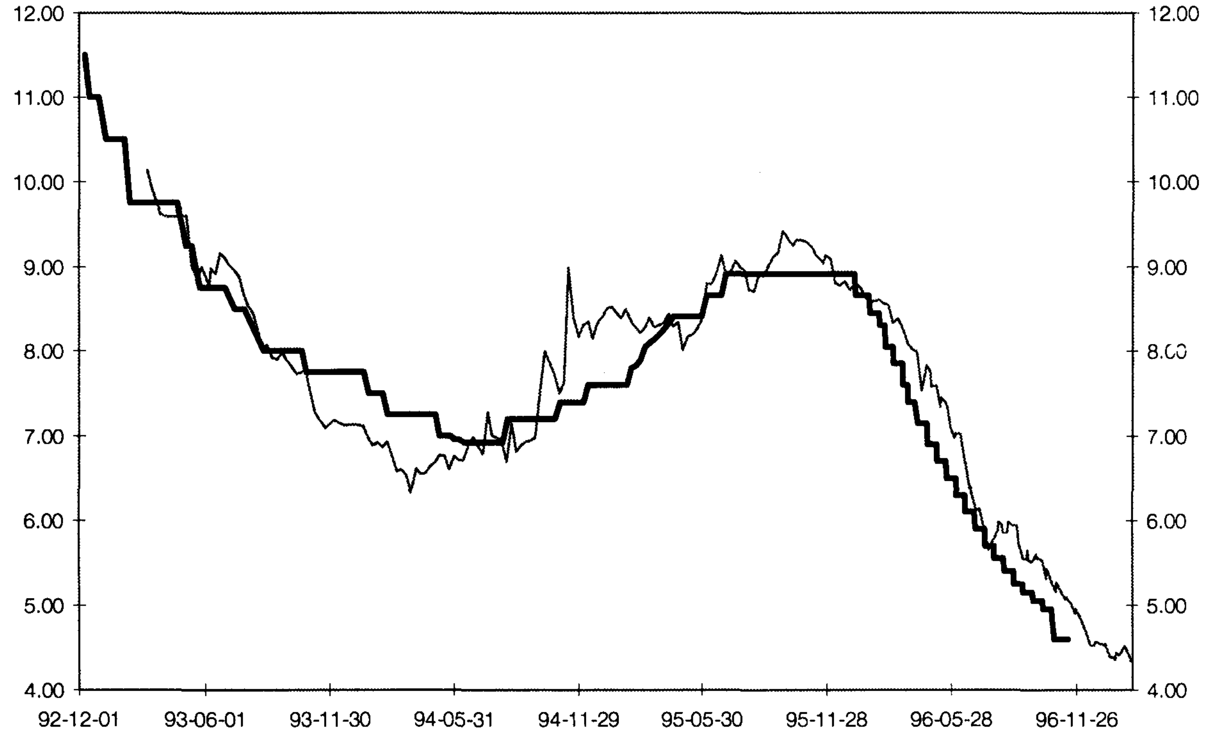
An ambition to be transparent and clear should be a fundamentally reasonable premise for any central bank. Transparency is particularly necessary when central banks become more powerful and independent. It is then all the more important that people are able to understand the central banks' objectives, assess their actions and call them to account. Moreover, transparency and clarity are natural components in the smooth functioning of a market-oriented monetary policy. If market agents do not understand the central bank's actions or feel deceived by the measures taken, monetary policy will be less effective. Furthermore, transparency is an important element in the process of establishing credibility for a new monetary policy regime.

4 A key rate can be defined as an operational target for a market determined interest rate or as an instrumental rate under the direct control of the central bank.

The Riksbank's intention has been to be transparent in its monetary policy considerations since the explicit inflation target was introduced. There are various ways in which a central bank can influence expectations about monetary policy. The traditional channel of information are speeches and lectures by the Governor and staff of the Riksbank. The Riksbank also issues an inflation report four times a year to present its assessment of future inflation and the conclusions for monetary policy to the financial markets and to the public. In this way the markets get an indication of the Riksbank's intentions and changes in monetary policy will not come as a surprise. The reports also raise the Riksbank's accountability: the analysis behind monetary policy actions is continuously open to public scrutiny and the performance of monetary policy can be evaluated against the objectives.

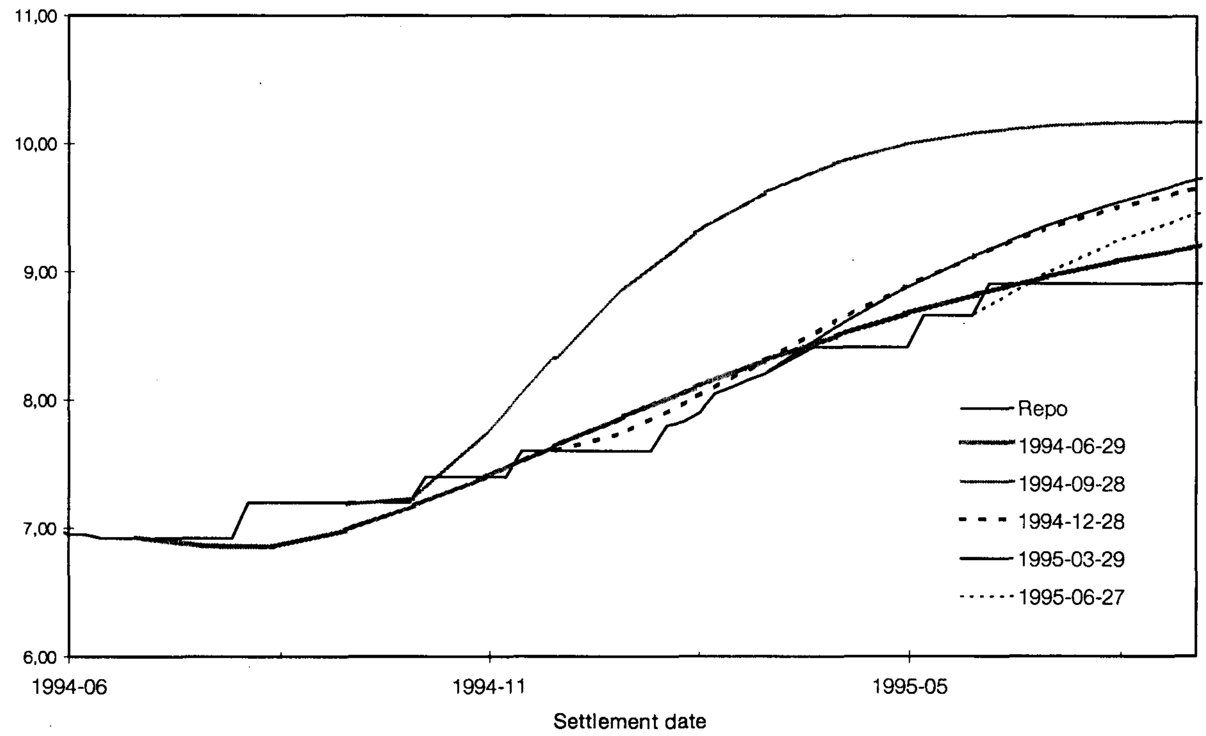
The market participants have been quite successful in predicting the Riksbank's actions in the short run during the last year. Figure 4 shows the actual repo rate and the expectations three months earlier measured by the overnight forward rate on the same horizon.

Figure 4
The repo rate and the overnight forward rate, lagged three months



However, there are also episodes when the market participants have failed to predict the repo rate well on a three month horizon. An example of such a period is from mid-1994 to mid-1995. Figure 5 shows the repo rate and the development of the overnight forward rate curve during this period. In August 1994 the Riksbank started to increase the repo rate due to a higher inflation pressure in the economy: the output gap was shrinking, inflation expectations increasing and monetary conditions were fairly expansionary due to the weakness of the krona. The repo rate was then gradually increased by about 2 percentage points to 8.91% in July 1995. The position of the overnight forward curve in late June 1994 indicates that market participants anticipated a tighter monetary policy, but only in the longer perspective. In the short run, they seem rather to have been expecting a lower instrumental rate. The latter was perhaps due to the inflation report in June 1994, which gave a fairly optimistic picture of the inflation pressure. However, new information arrived during the summer that made an immediate monetary contraction unavoidable. The markets seem to have overreacted on the initial interest rate increase with the overnight forward rate curve reaching levels of 9 to 10% within a horizon of a few months. This was partly due to the political turbulence in connection with the general election in September 1994, but there were also speculations about a return to the old high inflation regime and thus higher risk premia (see Dillén (1996)). After a few months, however, interest rate expectations stabilised along a path that was more in line with the Riksbank's intentions.

Figure 5
Repo rate and overnight forward rate curves, 1994-95



In 1994 there was a general lack of credibility in the ability to conduct an overall economic policy consistent with price stability. There was also a deep concern about the ability to consolidate government finances, which showed a deficit of 12% of GDP in 1993. These credibility problems resulted in a weak and volatile krona exchange rate, which created substantial difficulties in formulating the monetary policy. The volatility of the exchange rate implied that the Riksbank could not control the monetary conditions; that is, the weighted sum of real interest rates and the effective real exchange rate, in the short run. Hence, the so called Monetary Conditions index could not play the role of an operational target and was only used as an indicator of the monetary stance. The exchange rate was in practice treated as endogenous in the inflation forecast and made conditional on, for instance, an assumption of how market participants would react when the success of the budget consolidation became clearer. In such an environment, it is not always easy to be transparent and to give a clear picture of the monetary policy considerations. The best one can do is perhaps to try to focus the debate on fundamental issues.

The conditions for monetary policy changed during 1995. The krona appreciated by approximately 5% in effective terms from January to October 1995 and inflation expectations, according to surveys, came down significantly. The twelve-month rate of inflation was 2.7% in October 1995, which was a decrease of 0.6 percentage point compared with the peak in April 1995 (see Figure 6).[5]

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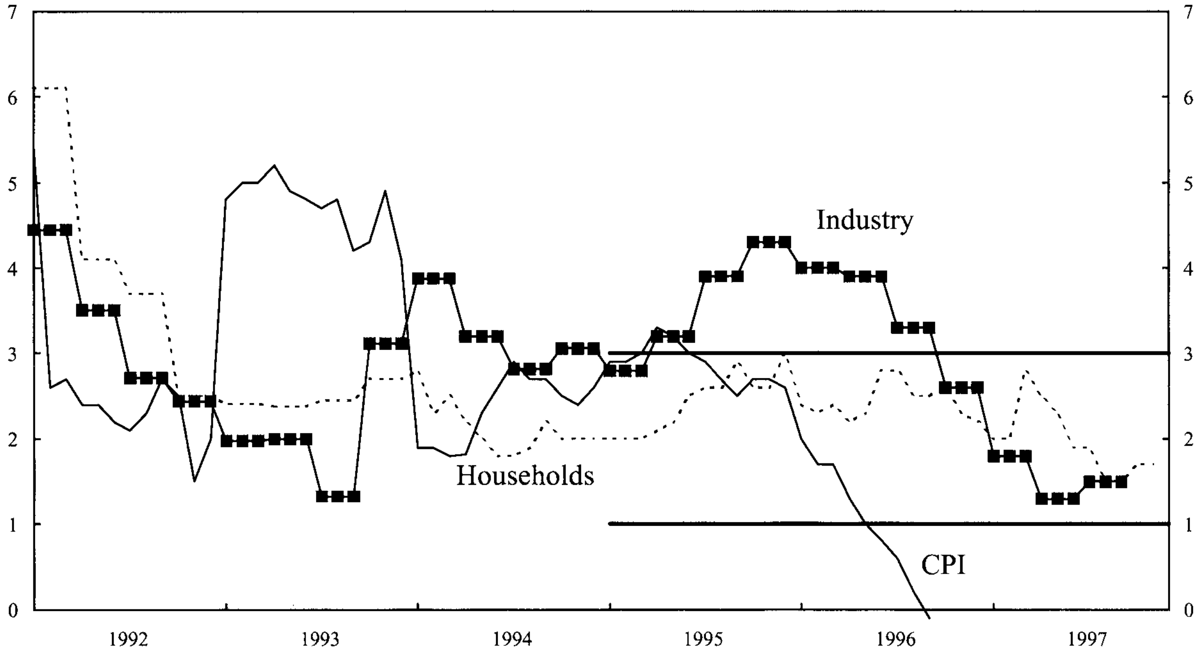
[5] Implicit forward rates are estimated by extending the functional form of Nelson and Siegel (1987); see Svensson (1994).

Figure 6
CPI and inflation expectations of households and industry
Twelve-month changes, in percentages



Note: The curves for expectations have been shifted 12 months into the future, so that they coincide with the period to which the expectations refer.

The situation was approaching a point where it should be feasible to ease monetary policy and lower the repo rate. But as the Riksbank still did not consider that inflation could fall below 2% 1-2 years ahead, there was no cause to alter the monetary stance and the repo rate was left unchanged at 8.91%.

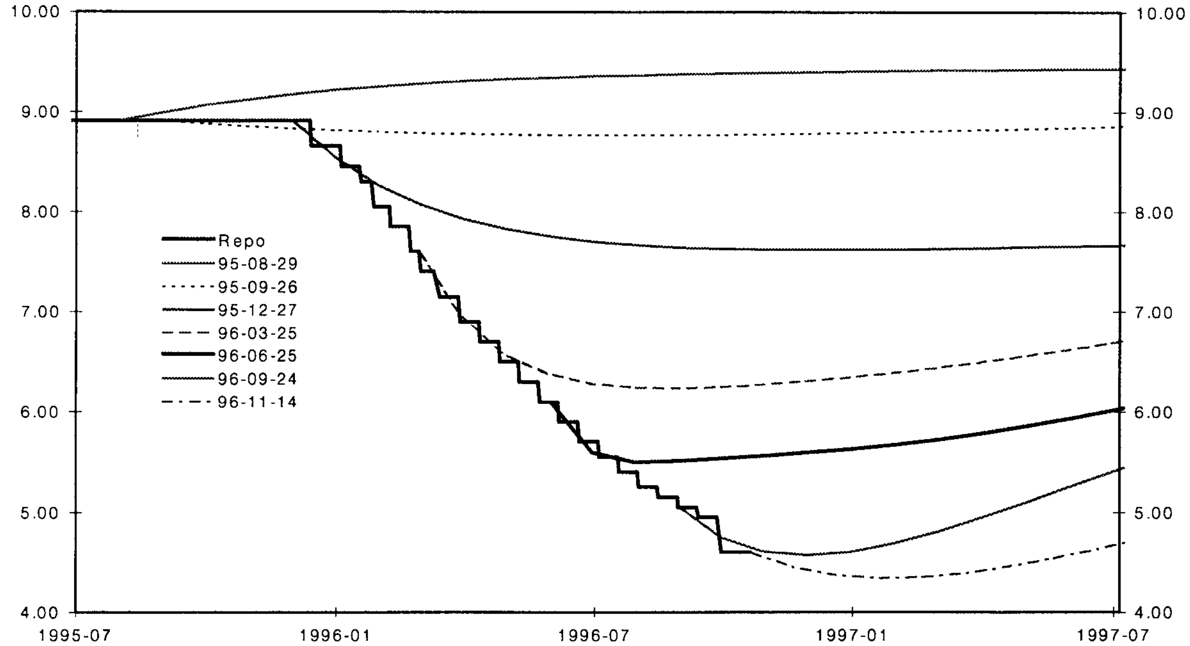
Monetary policy was debated intensely around Christmas 1995, when a majority of observers considered that the Riksbank ought to lower the repo rate. Besides coming from a number of the most frequent domestic contributors to the economic policy debate, this view was heard from foreign stockbrokers and others. However, none of the more established observers or forecasters of the Swedish economy counted on the Riksbank fulfilling its inflation target in 1996 and 1997. At the Riksbank the inflation forecast was gradually revised towards the end of 1995. This was accompanied by an increased probability of an alternative where weaker economic activity pointed to lower inflation. The latter was also something to allow for in the decisions. As a rule, monetary policy decisions are not based on an isolated estimate of future inflation; a number of alternatives are studied and the decisions stem from an assessment of their respective probabilities. In January 1996 this led to the consideration that the time was ripe to start lowering the repo rate.

The tactics involved beginning with relatively large steps (25 basis points initially) at fairly regular intervals. As new, favourable information on inflationary pressure flowed in, the assessment of how far down the repo rate would be able to move was revised gradually. The interest rate corridor was adjusted accordingly and more repo rate cuts followed in somewhat smaller steps. In this process, the adjustments of the interest rate corridor were used as a tool to signal the future direction of the repo rate and the speed of adjustment.

It is conceivable that the new information would have warranted cuts in larger steps. However, larger steps could have induced the market to expect lower rates than those that could be implemented with certainty. There was also a general concern about the credibility of the inflation target. The sequence of broadly uniform cuts therefore became relatively long. If today's picture had been completely clear from the start, a couple of larger reductions during the spring might have seemed natural. At the same time it should be emphasised that there are no ties to any particular pattern. The tactics are always subordinate to the objective of fulfilling the inflation target; new information about inflationary pressure in the economy can always justify a reassessment of the tactics.

On the whole, the actions taken seem to have been intelligible. During the spring and summer 1996 the market's picture of how much the interest rate might be lowered was revised to about the same extent as the Riksbank adjusted its assessment. A picture of how the perceived potential for cuts changed can be derived from the path of the repo rate in relation to the development of the overnight forward curve. For instance, at the end of March the market envisaged that the repo rate would be lowered to just over 6%. That was also approximately the Riksbank's position at that time (see Figure 7).

Figure 7
Repo rate and overnight forward rate curves, 1995-96



From January to October 1996 the policy was successful in the sense that the repo rate could be lowered by more than four percentage points without leading to a weaker krona or higher bond rates. In fact, the opposite occurred: the krona was stronger and bond rates lower in October 1996 than in the beginning of the year. The favourable development of bond rates was even clearer in terms of the differential against German rates and the total effective appreciation of the krona since its weakest position in April 1995 was about 15%. In the inflation report that was published in September 1996 it was concluded that the inflation rate would be in line with the 2% target during 1997 as well as in the first half of 1998.

To conclude, the repo rate has been adjusted gradually in fairly small steps. This pattern is more a result of corresponding changes in the assessment of future inflation than of preferences for interest rate stability. Transparency and clearness have also become an important element of the Riksbank's monetary tactics and are considered necessary to gain credibility and support for the inflation target. The ambition to be transparent and clear together with the inflation target implies that our public assessments of future inflation should have an impact on the short-term market rates. However, market expectations are also influenced by the actual magnitude and frequency of repo rate adjustments together with the Governing Board's decisions to alter the interest rate corridor. Empirical tests of how speeches, inflation reports and changes in instrumental rates affect market interest rates are presented in the next section.

3 Impact of monetary announcements on market interest rates

3.1 Impact of inflation reports and speeches

In Table 2 we report the impact of inflation reports and speeches by the Governor and Deputy Governors on market interest rates. We have controlled for changes in the repo rate and the interest rate corridor (captured by changes in the lending rate), which in some cases took place on the same day.[6] The estimated model is

$$\begin{aligned} &\Delta r_{it} = \beta_0 + \beta_1 \Delta r_{i,t-1} + \beta_2 REPORT_t + \beta_3 SPEECH_t + \beta_4 \Delta R_t + \beta_5 \Delta R_{t-1} + \beta_6 \Delta L_t + u_t, \\ (1)\quad & u_t | I_{t-1} = N(0, h_t), \\ & h_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 h_{t-1}, \end{aligned}$$

where $i \in \{$3-month bills, 2-year bonds$\}$, ΔR_t is the change in the repo rate, ΔL_t is the change in the interest rate corridor, the variable $REPORT_t$ ($SPEECH_t$) is a dummy variable that takes the value 1 (-1) if the inflation report (speech) was interpreted (by us) as foreboding monetary tightening (easing) and the value 0 if the report (speech) was neutral. Out of 56 speeches, 12 were seen as foreboding tightening, 9 as foreboding easing, and the rest as neutral or touching subjects other than the inflation outlook and the prospects for monetary policy. The ten inflation reports were coded in the same way: 3-5-2.[7] According to Table 2, the inflation reports have no significant intra-day effect on the 3-month bill rate or the 2-year bond rate, but the coefficients are positive as expected. The problems of finding significant intra-day effects from the inflation reports are not surprising. On some occasions the instrumental rates were changed just before the publishing of a report. The Riksbank thereby revealed, at least implicitly, the conclusions of the reports in advance. Speeches have an effect of approximately two basis points on the 3-month bill rate, which is significant at the 10% level. We will discuss the impact of instrumental rate changes in the next section.

3.2 Impact of key rate changes

Cook and Hahn (1989) examine the influence of monetary policy on interest rates by estimating the effect of changes in the federal funds rate target on market interest rates. They found that changes in the target caused large movements in short-term rates and smaller but significant movements in intermediate- and long-term rates. Also, the magnitude of the effect on the short 3-, 6- and 12-month rates were very similar. Dale (1993), studying the UK market, extended their analysis to take into account the time elapsed between changes and asymmetric responses to those changes as well as turning points in the direction of key rate changes. His results are very similar to those of Cook and Hahn. In addition he finds a significant turning point effect. However, he finds no evidence that the response of market rates to a change in the key rate depends on the time elapsed since the previous key rate change – the duration of the no change period. Nor does he find any evidence that

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[6] If the speech was held after 4.00 p.m. the day after the speech is considered as the announcement date, since we use closing market rates quoted at 4.00 p.m.

[7] A list of the key rate change announcements and the dates of the inflation reports together with the classification are in Appendix A and B, respectively.

Table 2
Impact on market rates from Sveriges Riksbank inflation reports and speeches by the Governor and Deputy Governor of the Riksbank

Variable	3-month T-bill	2-year T-bond
Mean equation intercept	-0.004 (2.385)	-0.008 (2.986)
$\Delta r_{i,t-1}$	0.067 (1.907)	0.046 (1.307)
$REPORT_t$	0.016 (0.766)	0.001 (0.019)
$SPEECH_t$	0.022 (1.824)	0.014 (1.064)
ΔR_t	0.104 (2.496)	0.087 (1.956)
ΔR_{t-1}	0.084 (2.123)	0.037 (0.773)
ΔL_t	0.032 (1.111)	0.072 (2.145)
Variance equation intercept	0.0001 (3.014)	0.0007 (4.522)
u_{t-1}^2	0.063 (5.399)	0.173 (6.683)
h_{t-1}	0.911 (70.175)	0.753 (23.980)

Notes: t-values are reported within parentheses. The variable $REPORT_t$ ($SPEECH_t$) is a dummy variable that takes the value 1 (-1) if the inflation report (speech) was interpreted (by us) as foreboding monetary tightening (easing) and the value 0 if the report (speech) was neutral.

market rates respond asymmetrically to positive and negative changes or non-linearly to big and small changes in the key rate.

We estimate the following equation for the change in a market interest rate with maturity i on the day of the key rate change announcement:

(2) $$\Delta r_{it} = \beta_0 + \beta_1 \Delta R_t + \beta_2 (D_t - D_{t-1}) \cdot S_t + \beta_3 \Delta L_t + \beta_4 TP_t \cdot S_t + u_t,$$

where $i \in$ {rates on 3-month bills, 6-month bills, 12-month bills, 2-year bonds, 5-year bonds, 10-year bonds}, $t \in$ {day of key rate change announcement}, ΔR_t is the change in the repurchase rate, D_t is the duration of the no change period, measured as the number of calendar days since the previous repo rate change (not counting the announcement days), S_t is a dummy variable for the sign of the repo

Table 3
Impact on market rates from key rate changes

Panel A: Impact on announcement day

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t	0.216 (5.253)	0.159 (3.004)	0.137 (2.423)	0.117 (1.875)	0.097 (1.625)	0.049 (0.854)
$(D_t - D_{t-1}) \cdot S_t$	-0.001 (4.408)	-0.001 (3.758)	-0.001 (2.975)	-0.001 (3.304)	-0.001 (2.483)	-0.001 (2.013)
ΔL_t	0.027 (0.833)	0.059 (1.397)	0.013 (0.306)	0.054 (1.084)	0.041 (0.856)	0.030 (0.653)
$TP_t \cdot S_t$	0.282 (5.687)	0.454 (7.100)	0.500 (6.651)	0.382 (5.279)	0.309 (4.444)	0.493 (6.507)
R^2	0.601	0.598	0.284	0.533	0.423	0.321
DW	1.888	2.230	2.347	2.115	2.366	2.202

Panel B: Combined impact on announcement day and day after

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t	0.346 (5.499)	0.265 (3.210)	0.279 (3.181)	0.227 (2.352)	0.188 (2.091)	0.117 (1.350)
$(D_t - D_{t-1}) \cdot S_t$	-0.001 (4.038)	-0.002 (3.335)	-0.001 (2.490)	-0.002 (3.076)	-0.001 (2.206)	-0.001 (1.774)
ΔL_t	0.066 (1.312)	0.116 (1.764)	0.064 (0.991)	0.147 (1.907)	0.141 (1.971)	0.169 (2.438)
$TP_t \cdot S_t$	0.493 (6.507)	0.694 (6.974)	0.335 (2.486)	0.753 (6.484)	0.540 (4.994)	0.397 (3.792)
R^2	0.649	0.606	0.308	0.558	0.458	0.363
DW	2.368	2.275	2.380	2.047	2.227	2.031

Panel C: Combined "impact" over the two days prior to a key rate change

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t	0.432 (5.604)	0.313 (4.518)	0.254 (2.458)	0.223 (2.410)	0.196 (1.956)	0.170 (1.586)
R^2	0.370	0.281	0.143	0.111	0.097	0.078
DW	1.457	1.547	1.399	1.855	1.871	1.746

rate change (i.e. $S_t = 1$ if $\Delta R_t > 0$ and $S_t = -1$ if $\Delta R_t \leq 0$), ΔL_t is the change in the interest rate corridor, TP_t is a dummy variable for turning points in the key rate change variable (i.e. $TP_t = 1$ if the sign of ΔR_t is different from the sign of ΔR_{t-1} and = 0 otherwise).

In Table 3 Panel A, the impact on market rates from a change in the repo rate is seen to be small on the announcement day. Only 21.6% of the change is impounded in the 3-month rate on that day. The impact is monotonically decreasing in maturity. For the 10-year bond rate the impact is only 4.9%. Taking into account the day after the announcement increases the impact to 34.6% for the 3-month bill rate and 11.7% for the 10-year bond rate. There thus seems to be some delay in the market's reaction to a repo rate change. This impact can be compared to those found for the same maturities by Cook and Hahn (1989) for the United States and Dale (1993) for the United Kingdom. Cook and Hahn found impacts of around 50% , while Dale found impacts of 20-30% for the 3-, 6- and 12-month maturities on the announcement day. Thus, the impact is much smaller on the announcement day in Sweden. We will come back to the reasons for this below.

A lengthening of the duration of the no change period is seen to have a negative effect on market rates (the coefficients of -0.001 are significant at the 5% level for all maturities). Hence, a lengthening of the duration between repo rate changes by ten days decreases the impact on market rates by one basis point. The market seems to interpret a lengthening in the duration as a signal that the trend of repo rate changes has been weakened. Changes in the interest rate corridor have positive signs for all maturities, but are not statistically significant on the announcement day. However, if the day after the announcement is included the impact is bigger and significant at the 5% level for the longer maturities. The turning point coefficient estimates are quite big as we would expect.

Could the low impact on market rates be due to the repo rate changes having been anticipated by the market? We address this question in Panel C, where we have used as regressand the change in market rates over the two days preceding a repo rate change. It is seen that the changes in the repo rate were to a large extent expected by the market. 43.2% of the change in the repo rate is reflected in the 3-month rate over the two days prior to the announcement. We also note that the "impact" is monotonically decreasing in maturity. For the 10-year bond rate the "impact" is 17%. The Figures in Panel C are much higher than the 15-20% reported by Dale (1993) for the United Kingdom.

Table 4

Expectations of key rate changes in 1996 compared to the 1992-95 period: combined "impact" over the two days prior to a key rate change

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t, $t = 1,..,34$	0.471 (4.584)	0.312 (3.479)	0.231 (1.427)	0.201 (1.583)	0.183 (1.313)	0.153 (1.029)
ΔR_t, $t = 35,..,61$	0.174 (0.853)	0.248 (1.158)	0.399 (1.813)	0.178 (0.721)	0.106 (0.405)	0.102 (0.351)

In Section 2 we discussed the efforts by the Riksbank to conduct a transparent monetary policy, especially in the most recent period. This should be reflected in the markets better anticipating changes in the repurchase rate. However, the evidence seems to point in the opposite direction in Table 4. There we report the results for two sub-periods. The same model presented in Panel C of Table 3 has been estimated for the two sub-periods 3rd December 1992 to 4th July 1995 and 9th January 1996 to 24th October 1996 but only the coefficients for the repo rate change variable are reported. The "impact" on the two days prior to an announcement is 17.4% for the most recent sub-period compared to 47.1% for the earlier period. However, this result only says how much expectations were revised over the two days prior to an announcement and does not, for instance, exclude the possibility that expectations in the longer term were more in line with the repo rate in the latter period. We therefore also tested the predictive ability of the overnight forward rate on a 3-month horizon depicted in Figure 4, comparing the 1996 period with the previous period. This is simply done by regressing the forward rate on the repo rate. The predictive ability is quite high for both periods, the coefficient estimates are 0.97 and 1.02 respectively. The difference is significant at the 1% level according to a formal Chow test. This gives a more satisfying verdict on the transparency of recent monetary policy than the results presented in Table 4.

Table 5

Non-linear impact on market rates

Panel A: Impact on announcement day

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t^b	0.199 (4.301)	0.129 (2.195)	0.126 (1.890)	0.065 (0.957)	0.053 (0.818)	0.013 (0.207)
ΔR_t^s	0.140 (0.969)	0.085 (0.463)	0.127 (0.688)	0.340 (1.600)	0.308 (1.511)	0.305 (1.559)
R^2	0.616	0.623	0.280	0.588	0.491	0.392
DW	1.882	2.207	2.376	2.025	2.210	2.017
F (prob.)	0.159	0.816	0.997	0.211	0.226	0.150

Panel B: Combined impact on announcement day and day after

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t^b	0.328 (4.564)	0.224 (2.422)	0.292 (2.858)	0.168 (1.554)	0.145 (1.449)	0.081 (0.835)
ΔR_t^s	0.261 (1.161)	0.278 (0.960)	0.412 (1.482)	0.432 (1.280)	0.406 (1.297)	0.378 (1.250)
R^2	0.657	0.624	0.317	0.587	0.489	0.385
DW	2.228	2.179	2.375	1.961	2.042	1.835
F (prob.)	0.771	0.856	0.674	0.446	0.417	0.340

Panel C: Combined "impact" on the two days prior to a change

Variable	3-month	6-month	12-month	2-year	5-year	10-year
ΔR_t^b	0.477 (5.701)	0.335 (4.364)	0.287 (2.309)	0.227 (2.148)	0.203 (1.763)	0.177 (1.451)
ΔR_t^s	0.652 (2.489)	0.509 (2.118)	0.278 (1.000)	0.292 (0.883)	0.244 (0.679)	0.207 (0.542)
R^2	0.437	0.323	0.155	0.111	0.087	0.063
DW	1.536	1.665	1.458	1.891	1.924	1.835
F (prob.)	0.516	0.482	0.976	0.848	0.911	0.939

We have also estimated equation (2) with the ΔR_t variable split into big and small repo rate changes to see if there is a non-linear impact. We have defined a small change to be a change which is greater than or equal to 20 basis points; a big change thus exceeds 20 basis points. The results are given in Table 5, where only the coefficients of the repo rate changes are reported. The hypothesis of a linear impact cannot be rejected in formal F-tests. Thus, there is no evidence that big and small changes in the repo rate have different impacts on market rates. For instance, about one fifth of a repo rate change is reflected in the 3-month rate, irrespective of the size of the change.

3.2 Impact of key rate changes on interest rate volatility

In this section we consider the impact of key rate changes on the volatility in market rates. We estimate the model:

$$\text{(3)} \qquad \ln\sigma_{it} = \omega_0 + \omega_1 \ln\sigma_{i,t-1} + \omega_2 |\Delta R_t| + \omega_3 (D_t - D_{t-1}) + \omega_4 |\Delta L_t| + \omega_5 TP_t + u_t,$$

where again $t \in \{\text{day of key rate change announcement}\}$. The volatility is defined as the standard deviation of daily interest rate changes in the days following an announcement:

$$\sigma_{it} \equiv \left[\frac{1}{\min\{10, D_{t+1} - 2\}} \sum_{s=1}^{\min\{10, D_{t+1}-2\}} \left(\Delta r_{it_s}\right)^2 \right]^{1/2} \quad \text{where} \quad t < t_1 < t_2 < \cdots < t_{D_{t+1}} < t+1.$$

We have not considered a period of more than ten business days after a key rate change in computing the standard deviation. The reason is that we think it is doubtful that the impact would be felt for a longer period, considering that many other things will have happened in the meantime. We also stop two days before the next key rate change announcement if the announcements come that close together. This results in the sample size being reduced to 31 observations.

Table 6

Impact on volatility from key rate changes

Variable	3-month	6-month	12-month	2-year	5-year	10-year
intercept	0.005 (0.436)	0.013 (1.125)	0.234 (1.628)	0.045 (2.578)	0.052 (2.565)	0.053 (2.547)
$\ln\sigma_{i,t-1}$	0.217 (1.402)	0.326 (2.510)	-0.078 (0.393)	0.410 (3.566)	0.399 (2.899)	0.439 (3.162)
$\|\Delta R_t\|$	0.150 (2.903)	0.085 (2.143)	-0.432 (0.846)	-0.014 (0.290)	-0.035 (0.621)	-0.055 (0.965)
$D_t - D_{t-1}$	-0.0002 (1.088)	-0.0002 (1.729)	-0.0004 (0.272)	-0.0005 (3.256)	-0.0004 (2.394)	-0.0004 (1.961)
$\|\Delta L_t\|$	0.041 (0.938)	0.046 (1.233)	0.010 (0.021)	0.066 (1.372)	0.069 (1.245)	0.086 (1.533)
TP_t	0.087 (2.885)	0.105 (4.042)	0.249 (0.723)	0.162 (4.702)	0.131 (3.256)	0.118 (2.889)
R^2	0.571	0.620	0.053	0.710	0.602	0.605

In Table 6 there is strong evidence of persistence in volatility, even with the timing conventions we have used in this analysis. The absolute value of a repo rate change has a significantly positive effect only on the volatilities of the 3-month and 6-month interest rates. The absolute value of a change in the interest rate corridor has the expected positive sign, but is not statistically significant at the 5% level. However, the point estimates suggest that the effect is strongest on the longer maturities. We also note the high volatility in connection with a turning point in the direction of key rate changes (keep in mind though that there are only two observations on turning points in the sample). There is also some evidence that lengthening the duration of the no-change period has a dampening effect on volatility in the days after a key rate change.

Conclusions

In this paper we have explained the current system of interest rate policy instruments in Sweden, which was introduced in 1994 as a response to the move to a flexible exchange rate. The tactics of policy rate adjustments and the need for transparency and information disclosure with an explicit inflation target were discussed. The repo rate, the Riksbank's primary instrumental rate, has been adjusted gradually in fairly small steps. This pattern is more a result of corresponding changes in the assessment of future inflation than of preferences for interest rate stability.

The Riksbank has tried to be more transparent in its monetary policy considerations since the shift to the explicit inflation target. However, it is not always easy to interpret the considerations behind monetary policy decisions when there is turbulence in the markets and the overall picture of the state of the economy is blurred. Improved credibility and a more stable situation in the economy during 1996 made it easier in this respect. The communication of the assessments of future inflation and conclusions for monetary policy have run more smoothly and the markets seem to have understood where the Riksbank has been aiming. This view is supported by the position of the overnight forward rate curve, which reflects expectations about future repo rates, at different points in time.

We examined the influence of monetary policy announcements on interest rates by estimating the effects of speeches, inflation reports and changes in the instrumental rates on market interest rates. First, speeches by the Governor and the Deputy Governors influence short-term market interest rates in the way they are intended. For instance, short-term market rates tend to increase when the Governor express worries about the inflation pressure in the economy. Second, changes in the repo rate were to a large extent anticipated by the market, as evidenced by changes in market rates on the two days preceding the announcement of a repo rate change. A third observation is that the impact on the announcement day is monotonically declining in the maturity of the bond. Moreover, a lengthening of the duration between repo rate changes had a dampening effect on the impact of a repo rate change. Finally, a key rate change led to higher volatility on the days following the announcement of the change.

Appendix A

Key rate changes, December 1992 to October 1996

Obs	Announcement	Repo rate	Repo rate change	Deposit rate change	Lending rate change
1	1992-12-03	11.50	-1.00		
2	1992-12-14	11.00	-0.50		
3	1992-01-05	10.50	-0.50		
4	1993-02-05	9.75	-0.75		
5	1993-04-23	9.50	-0.25		
6	1993-04-29	9.25	-0.25		
7	1993-05-13	9.00	-0.25		
8	1993-05-19	8.75	-0.25		
9	1993-07-01	8.50	-0.25		
10	1993-08-05	8.25	-0.25		
11	1993-08-12	8.00	-0.25		
12	1993-10-21	7.75	-0.25		
13	1994-01-20	7.50	-0.25		
14	1994-02-17	7.25	-0.25		
15	1994-05-05	7.00	-0.25		
16	1994-05-26	6.95	-0.05		
17	1994-06-14	6.92	-0.03		
18	1994-08-11	7.20	0.28	0	0.50
19	1994-11-01	7.40	0.20		
20	1994-12-13	7.60	0.20		
21	1995-02-09	7.80	0.20	0.50	0.50
22	1995-02-21	7.83	0.03		
23	1995-02-28	7.90	0.07		
24	1995-03-07	8.05	0.15		
25	1995-03-14	8.10	0.05		
26	1995-03-21	8.15	0.05		
27	1995-03-28	8.20	0.05		
28	1995-04-04	8.27	0.07		
29	1995-04-11	8.34	0.07		
30	1995-04-12			1.00	0.50
31	1995-04-18	8.41	0.07		
32	1995-06-06	8.66	0.25		
33	1995-06-29			0.50	0.50
34	1995-07-04	8.91	0.25		
35	1996-01-09	8.66	-0.25		
36	1996-01-30	8.45	-0.21		
37	1996-02-13	8.30	-0.15		
38	1996-02-22	8.05	-0.25	-0.50	-0.50
39	1996-03-05	7.85	-0.20		
40	1996-03-19	7.60	-0.25		
41	1996-03-21			-0.75	-0.75
42	1996-03-26	7.40	-0.20		
43	1996-04-09	7.15	-0.25		
44	1996-04-23	6.90	-0.25		
45	1996-04-25			-0.75	-0.75
46	1996-05-07	6.70	-0.20		

Key rate changes, December 1992 to October 1996 (cont.)

Obs	Announcement	Repo rate	Repo rate change	Deposit rate change	Lending rate change
47	1996-05-21	6.50	-0.20		
48	1996-06-04	6.30	-0.20		
49	1996-06-18	6.10	-0.20		
50	1996-06-20			-0.75	-0.75
51	1996-07-02	5.90	-0.20		
52	1996-07-16	5.70	-0.20		
53	1996-07-30	5.55	-0.15		
54	1996-08-13	5.40	-0.15		
55	1996-08-15			-0.50	-0.50
56	1996-08-27	5.25	-0.15		
57	1996-09-10	5.15	-0.10		
58	1996-09-24	5.05	-0.10		
59	1996-10-08	4.95	-0.10		
60	1996-10-22	4.85	-0.10		
61	1996-10-24	4.60	-0.25	-0.50	-0.50

Appendix B

Inflation Reports

Inflation report publication date	Code	Repo rate change	3-month rate change	2-year rate change
1993-10-29	-1		-0.01	-0.01
1994-03-14	-1		-0.06	-0.09
1994-06-14	0	-0.03		
1994-10-18	1		+0.01	+0.02
1995-02-28	1	+0.07	+0.08	+0.01
1995-06-20	1		-0.01	0
1995-11-16	0			
1996-03-04	-1		0	+0.10
1996-06-05	-1		-0.08	-0.02
1996-09-24	-1	-0.10	0	+0.02

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The implementation of monetary policy in Italy: the role of repo operations and official rates

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Summary and introduction

In Italy, the tactics of monetary policy are based both on the setting of official rates and on open market operations, mainly conducted through variable rate auctions on securities repurchase agreements. Official rates are moved in discrete steps and infrequently; allotment rates at repo auctions are indirectly influenced by the Bank of Italy through liquidity control, and usually move in a more flexible and gradual way. This paper addresses the issue of their different role in monetary transmission.

Section 1 describes the main institutional features of the monetary instruments in Italy and discusses in some detail the setting of policy rates and their relation to liquidity management. Section 2 compares the Italian situation with that of other countries and discusses the implications of different tactics in interest rate management. Section 3 presents econometric estimates of the effect of both official rates and repo rates in monetary transmission (on bank rates, short and long-term market rates and non-financial agents' expectations).

1. Monetary policy instruments of the Bank of Italy

Since the eighties, a number of institutional reforms have improved the working of the monetary and financial markets and the effectiveness of indirect monetary control. Among these,[1] the creation of the screen-based interbank market (MID) in February 1990 and the introduction of reserve averaging in October 1990 were aimed at decreasing the volatility of very short-term interest rates and fostering their role as operating targets. Monetary procedures have increasingly focused on the control of very short-term interest rates.[2] To this end, the Bank of Italy relies mainly on two instruments: the setting of official interest rates and open market operations (mainly repurchase agreements).

The official discount rate and the rate on fixed-term advances are set by the Governor of the Bank of Italy.[3] They are changed infrequently and by relatively large increments: in the period between 1990 and 1996, the discount rate was changed, on average, every 98 days and by 75 basis points each time. The *discount rate* applies to ordinary advances,[4] a collateralised overdraft facility for

1 The main reforms concerned the working of the monetary and financial markets, the setting of official rates, the Treasury's accounts with the Bank of Italy and the required reserve regime. See Gaiotti and Salvemini (1992), Gaiotti (1992) and Passacantando (1996). On the passage from indirect to direct controls in the 1980s, see also Majnoni and Zautzik (1986).

2 This development is common to many other countries. According to BIS (1986), since the mid-1980s short-term rates have played a major role as operating targets in almost all countries, while changes in instruments and procedures were intended to make interest rate setting more flexible.

3 The Governor of the Bank of Italy has directly set official rates since 1992. Previously, the formal decision was taken by Treasury acting on a proposal from the central bank. See Passacantando (1996).

4 Ordinary advances derive from the "conti di anticipazione e deposito", which were used for transactions and as a liquidity buffer before the introduction of reserve averaging. Its role has diminished since then. The credit granted through this facility has gradually decreased since the mid-1980s (on September 1996 it was about 1.8 trillion lire);

commercial banks that is accorded automatically but whose amount is limited; although the discount rate has very little direct impact on the banks' refinancing costs,[5] it is seen by market participants as an important signal of the medium-term orientation of monetary policy. It is normally below market rates.

Fixed-term advances[6] are a standing facility to cope with unexpected end-of-day liquidity needs. Since May 1991, the rate on this facility has been uniform for all banks and equal to the discount rate plus a surcharge, as a consequence of reform aimed at increasing its role as an instrument of monetary policy and its signalling content. In normal conditions, the rate on fixed-term advances represents a ceiling on short-term fluctuations of money market interest rates. The Bank of Italy has occasionally rationed the supply of fixed-term advances, thus letting short-term rates temporarily rise above the rate on fixed-term advances.

Repurchase agreement operations[7] and *currency swaps*[8] are the main source of Bank of Italy refinancing to the banking system (Figure 1).[9] Repos are the more relevant in signalling the monetary stance to the market, since they are the instrument used to regulate liquidity in the face of

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since the overnight rate is usually above the discount rate, due to arbitraging all available credit on the overdraft is used.

5 Commercial bill discounting also exists but the amounts involved are negligible.

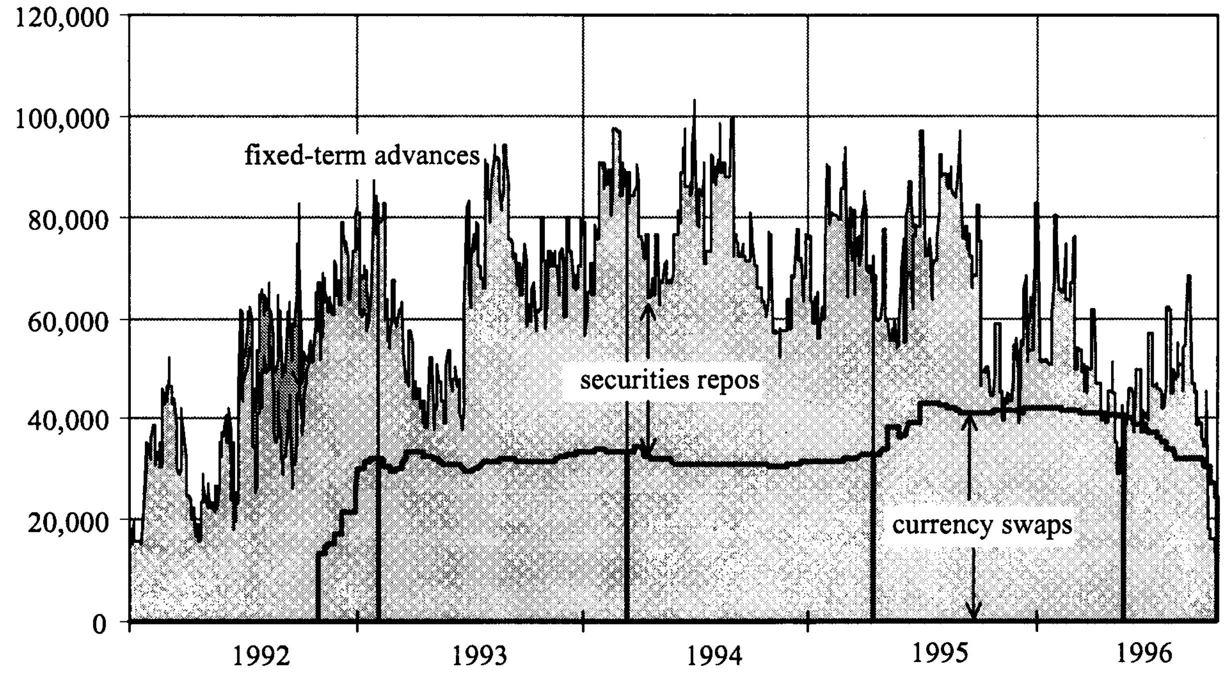
6 Fixed-term advances are activated upon a bank's request. The Bank of Italy retains discretion in accepting or refusing the requests.The maturity is set by the Bank of Italy, at between 1 and 32 days. However, banks can repay funds in advance, either fully or in part. The surcharge on the discount rate never exceeded 1.5 percentage points (its present level). Although the supply has occasionally been rationed, beyond the short run rationing may be difficult to implement, since it conflicts with the need to ensure financing for end-of-day shortages. In addition to the official rate, a penalty charge – equal to the discount rate plus 8 percentage points – is applied to advances granted after 4 p.m., near the closing of daily net settlement; this helps to avoid risks of *moral hazard* in using the facility.

7 Repo auctions are announced by the Bank of Italy early in the day on which the auction takes place, depending on its appraisal of liquidity conditions. Funds are allotted by American-type auctions, in which the Bank of Italy retains the possibility to cut the demand schedule *ex-post*, in order to limit excessive fluctuations in allotment rates. "Cuts" were used more frequently until the beginning of 1993. They have been used only once since then: on 25 August 1995 no applications were accepted at rates below 10%, contributing to stabilize short-term interest rates slightly above that level. Depending on the overall shortage or excess of liquidity created by autonomous factors, reverse repos may take the place of normal repos. Operations with very short maturity – even 1 day – have sometimes taken place, usually in the closing days of the reserve maintenance periods. Participation in securities repos is extended to a broad range of institutions, including all the banks and securities investment firms with a status of specialist in the screen-based market for Treasury bonds (MTS, Mercato telematico dei titoli di Stato).

8 Currency swaps were introduced in October 1992. They help to diversify the range of available instruments and remove the distortions that could at times be caused by either a scarcity of securities available (in periods of large indebtness of the banking system with the Bank of Italy) or a reluctance to mobilize them (in periods of falling prices). Their stock increased gradually from about 30 trillion lire to approximately 40 trillion in the first months of 1995; it has been gradually reduced to roughly 30 trillions in the second half of 1996. Tender procedures for currency swaps are like those for repos. Auctions are announced the day before the operation takes place. They are called on an irregular basis: on average 1-2 in US dollars and 2-3 in Deutsche marks per month. The maturity of the swaps is in most cases 1 month for operations in marks and 3 months for those in dollars.

9 Among other open market operations, since February 1994 the Bank of Italy has conducted *outright transactions in T-bills* through auctions with the primary dealers of the MTS. Given their short maturity, these operations are comparable to repos. They are mainly used to regulate liquidity when either the small amount or the urgency of the intervention required would prevent announcing a repo auction. *Outright transactions in Treasury bonds* at the initiative of the Bank of Italy are occasionally used to smooth excessive fluctuations in bond prices and to keep market conditions orderly; their volume is small in relation to market turnover. The Bank of Italy also participates in outright transactions taken at the initiative of the market and bilateral reverse transactions with primary dealers: the former help MTS specialists to overcome temporary shortages in particular securities, and are very often in the form of barter securities transactions.

Figure 1
Bank of Italy's financing of the banking system
In billions of lire



exogenous fluctuations both in demand (such as changes in required reserves) and supply (such as changes in foreign reserves or Treasury drawings on its deposit accounts with the Bank of Italy),[10] while currency swaps constitute a roughly constant stock of basic refinancing and are normally renewed at maturity. Repos take place as interest rate tenders. As Table 1 shows, they have no fixed periodicity or maturity; on average, there are one or two auctions per week, while most repos have a maturity ranging from between 10 and 20 days.

Daily liquidity fluctuations between two repo auctions caused by exogenous factors are normally dealt with by banks through *required reserve averaging*,[11] which was introduced in October 1990. Under the present system, banks are subject to both a daily liquidity constraint (they cannot mobilise more than 12.5% of the total required reserves on a single day) and an average monthly constraint (the average of excess reserves in the maintenance period must not be negative). In deciding the frequency and volume of its repo operations, the Bank of Italy takes into account both the liquidity available on a given day and the liquidity expected to be available over the entire reserve computation period, estimating the latter on the basis of forecasts for exogenous liquidity creation through autonomous channels and for the demand for cash.

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10 Since 1st January 1994, in compliance with the Maastricht treaty, the Treasury has no access to direct financing from the Bank of Italy. The Treasury holds two deposits with the Bank of Italy, the "Conto Disponibilità" ("Treasury payment account") and the "Fondo Ammortamento" ("Sinking fund for the redemption of government securities").

11 Reserve averaging was introduced with the explicit objective of fostering the development of the money market and increasing the information content of short-term interest rates; these results were undoubtedly achieved, as the volume of transactions on the screen-based market for interbank deposits increased substantially and the volatility of money market interest rates – especially the overnight rate – decreased dramatically. Banks must hold the required reserve balance, computed on the basis of the average stock of deposits in month t, on average over a maintenance period which runs from the 15th of month t+1 to the 14th of month t+2. The daily balance cannot be less than a given percentage (currently 87.5%) of the average requirement. Carry-over from one computation period to the next is not allowed.

Table 1
Security repurchase agreements of the Bank of Italy

Year	Auction			Quantity[1]			Maturity		
	number	partici-pants[2]	accepted bids[2]	offered[2]	demand-ed[2]	assigned[2]	mini-mum[3]	maxi-mum[4]	average[5]
1982	7	18	15	850	1,706	1,289	4	21	12
1983	17	10	6	1,168	1,838	1,168	6	26	14
1984	20	15	9	2,015	2,797	1,956	1	33	11
1985	20	18	9	1,975	3,640	1,975	2	29	13
1986	64	19	11	2,138	3,551	2,130	1	29	12
1987	31	24	14	2,573	4,529	2,573	2	31	11
1988	11	29	9	3,841	6,866	3,841	1	21	8
1989	11	27	12	2,955	4,837	2,920	2	25	8
1990	36	44	19	3,479	5,302	3,329	1	28	11
1991	77	41	23	3,500	5,695	3,234	2	28	14
1992	144	57	35	5,771	9,635	5,692	1	32	16
1993	110	52	28	6,141	11,716	6,089	1	32	19
1994	89	50	32	7,674	14,656	7,674	2	41	24
1995	74	51	28	8,074	14,799	8,030	3	35	19
1996 [6]	34	39	19	8,066	14,983	8,063	1	30	14

[1] Billions of lire. [2] Yearly average per auction. [3] Minimum maturity in the year. [4] Maximum maturity in the year. [5] Average maturity, calculated over all auctions in the year. [6] January-September.

Each day, the Bank reviews its estimates for excess reserves on the following day and computes an index of the interventions needed in the rest of the maintenance period to keep average excess reserves at zero, based on the available information on liquidity flows.[12] The supply at repo auctions is set on the basis of this information, although it may sometimes also reflect a desire to marginally tighten or loosen the liquidity conditions.

At the auction, each bank can present a single bid, specifying both the quantity demanded and the interest rate offered; the latter depends on the short-term interest rates that the bank expects to prevail over the remainder of the reserve maintenance period. The banks have two types of information on aggregate liquidity conditions: the running average of balances on the reserve account since the beginning of the period, which is published by the Bank of Italy on Reuters screens each day, and an estimate of the aggregate daily level of excess reserves, computed by private forecasters. The running average is only an approximate, backward-looking measure of the need for liquidity in the rest of the period. [13]

Econometric estimates show how the repo rate is affected by liquidity policy. The relation of the rate at each repo auction with the supply of liquidity, as measured by the two indices of

12 This index is described in Angeloni and Prati (1996).

13 This index is the best measure of the liquidity stance only if the agents have no information on the autonomous liquidity flows expected in the remaining days. A thorough examination of alternative definitions of this index, under different assumptions on the information set of market participants, is given in Angeloni and Prati (1996). They find that both the daily and monthly indices affect the overnight rate; among different versions of the monthly index, they also find that those embodying forward-looking information about liquidity flows perform better, although the simpler definition used here also performs well.

"daily" and "average" excess reserves, is shown in Table 2[14] (the repo rate is also regressed on its level at the preceding auction, on the discount rate prevailing at the time of the last auction and on its change since then).[15] The coefficient of the average index is significantly negative, indicating that a decrease in liquidity (for instance, due to a reduced supply of funds at the auction) induces an increase in the repo rate. The coefficient of daily balances has also the correct sign, but it is somewhat less significant.[16] Although the stable, negative relation with the supply of liquidity indicates that the allotment rates at repo auctions are affected by Bank of Italy policy, the relatively low R^2 of the regression (16.5%, corresponding to a standard error of the regression of 17 basis points) also suggests that their very short-term fluctuations cannot be fully interpreted as a monetary policy signal, but also reflect shifts in the demand schedule.

Table 2
Dependent variable: change in the allotment rate for Bank of Italy securities repurchase agreements[1]

constant	$REPO_{t-1}$	$\Delta DISC$	$DISC_{t-1}$	daily "liquidity"[2]	average "liquidity"[3]	R^2	SEE	DW	LM(1) test for auto-correlation
0.20 (2.2)	-0.04 (1.8)	0.51 (6.0)	0.02 (1.1)	-0.006 (1.8)	-0.03 (3.8)	0.17	0.17	2.3	[16%]

[1] OLS estimates. White's t-statistics in parentheses. Daily observations on auction days. Sample: 1993-1995. $REPO_{t-1}$: allotment rate at the preceding repo auction; $\Delta DISC$: change in the discount rate since the preceding repo auction; $DISC_{t-1}$: discount rate at the time of the preceding repo auction. [2] Daily excess reserves plus the portion of required reserves that can be mobilised, measured the day before the auction. [3] Cumulative sum of excess reserves since the beginning of the reserve computation period, divided by the number of days remaining in the period, measured on the day of the auction.

In one sense, official rates and the repo rate have opposite features: since the former are set directly by the Bank of Italy, they are a clear signal of the monetary policy stance, but their direct impact on banks' refinancing cost is negligible; the latter is more relevant in determining the actual cost of bank refinancing, but is only indirectly controlled and its short-run volatility also reflects factors other than Bank of Italy policy.

The behaviour of the two official rates and the auction rate on repos in the 1992-1996 period is shown in Figures 2a and 2b. All played a role in monetary policy management. When the need for a strong, unequivocal signal was felt, official rates were adjusted. The importance of the signalling effect of monetary policy actions increased in recent years: since the exchange rate was allowed to float, inflationary expectations have played an increasingly large role in monetary policy

14 The regression reproduces, for the repo rate and over the 1993-96 period, the analysis originally conducted by Angeloni and Prati (1996) on the overnight rate for the period 1991-92.

15 Different lag lengths were tested. F-tests suggested including the simultaneous value of the average index and one lag of daily liquidity. The average index used in the regressions is constructed as the cumulative sum of excess reserves since the beginning of the reserve computation period, divided by the number of days remaining in the period. This corresponds to the average excess reserves that would be necessary in the second part of the computation period to bring the total average to zero. The daily liquidity indicator is defined as daily excess reserves (balances on the reserve account less the requirement, plus the undrawn portion on the "conto di anticipazione") plus the portion of required reserves that can be mobilized.

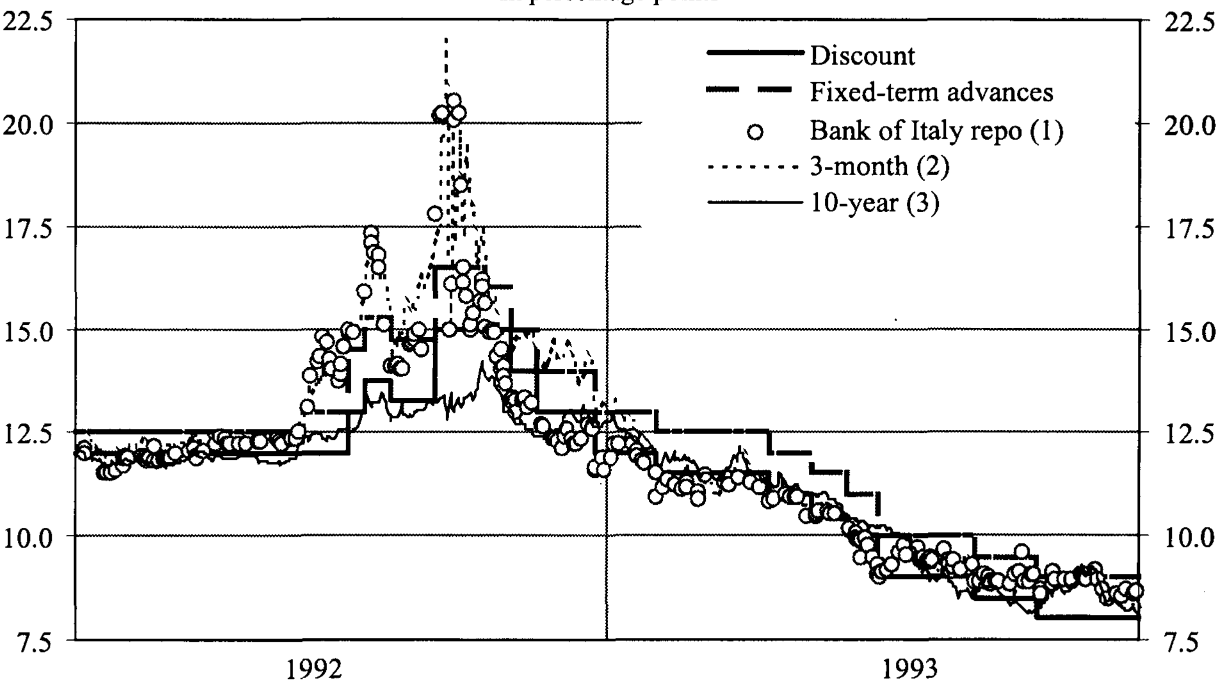
16 The effect of daily liquidity is much stronger on the overnight rate than on the repo rate, as both the results of Angeloni and Prati (1996) and our own estimates indicate.

transmission, both for their direct effect on prices and their indirect effect through the exchange rate.[17] Correspondingly, there has been increasing concern to send clear signals to the market and to act in advance, countering inflationary expectations before they translate into actual price increases;[18] this was done with relatively substantial moves in official rates (largely unexpected by the market) in August 1994 and in February and May 1995.[19]

Figure 2a

Monetary policy rates and market interest rates

In percentage points



(1) Marginal allotment rate. (2) LIBOR rate. (3) Swap rate.

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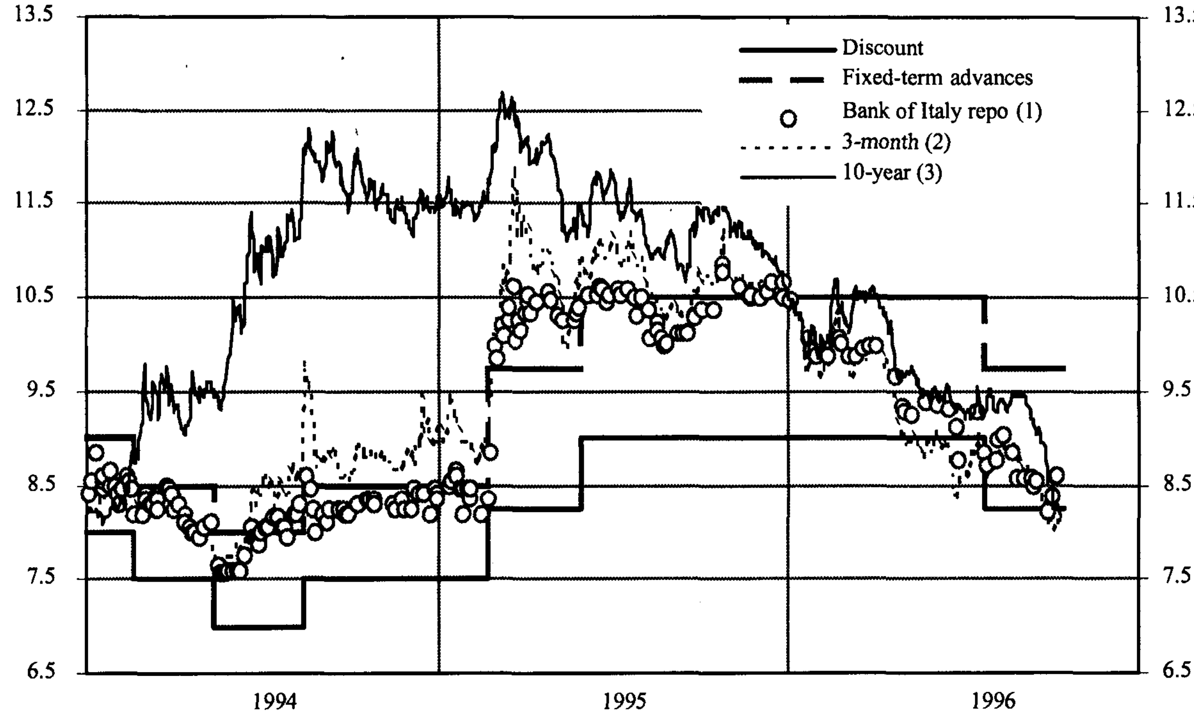
17 In the period during which the lira participated in the Exchange Rate Mechanism of the EMS, the strategy of monetary policy was based on the interaction of exchange rate control and interest rate policy (see Gressani, Guiso and Visco (1988)); targets for monetary and credit aggregates were also announced, since the large fluctuations margins of the lira and the controls on capital movements left monetary policy with some degrees of freedom. After 1992, in the absence of the nominal anchor provided by the exchange rate, the Bank of Italy put greater emphasis on the control of monetary aggregates. In recent years, the Bank of Italy has been more explicitly and directly linking its policy to the evolution of inflation: the explicit reference to the anti-inflationary objective is an essential element of its present strategy, although it does not implement a formal scheme of direct inflation targeting. (see Visco (1994) and Passacantando (1996)).

18 For instance, the Bank of Italy *Annual Report* for 1995 argues that "by orienting expectations, monetary policy can influence the inflation rate through an additional channel alongside its more traditional ones of aggregate demand regulation and direct impact on the exchange rate".

19 "The Bank of Italy raised official interest rates at the end of May; in the wake of the previous increases in August 1994 and February 1995, this constituted a further reinforcement of the restrictive monetary stance aimed at forcing down inflationary expectations" (Banca d'Italia, *Economic Bulletin* No. 22, February 1996, p. 44). This objective, already indicated in the press release on the occasion of the first rise, was emphasized even more explicitly in the case of the following move ("The increase is aimed at curbing inflation and countering the deterioration of inflationary expectations"). The increased need for pre-emptive measures to ward off inflation has also been repeatedly emphasized; indeed, a comparison of the movements in official rates and short-term interest rates at the time of the last three upturns in consumer price inflation (in October 1978, December 1986 and August 1994) indicates that the tightening of monetary conditions was more timely in the last instance (Banca d'Italia, *Annual Report* for 1994, pp. 84-85).

Figure 2b
Monetary policy rates and market interest rates
In percentage points



(1) Marginal allotment rate. (2) LIBOR rate. (3) Swap rate.

At the same time, the rate on repurchase agreements has been used with greater flexibility in the short run, when the Bank of Italy has sought to defuse short-term tensions without necessarily signalling a change in its medium-term orientation. The emergence of tensions on the foreign exchange market due to domestic or international shocks, and the recurrent worsening of expectations on the process of budgetary adjustment, have been countered by tightening liquidity conditions, reflected in the position of the repo rate with respect to the official rates. In some cases, there was a subsequent increase in the official rates, when the shock proved not to be temporary or when it started to feed back onto inflationary expectations. In some other cases, when tensions quickly abated, the increase in the repo rates was reversed. These tactics were employed several times in the course of 1995, when instability affecting the exchange rate and domestic securities prices was repeatedly generated by the volatility of expectations concerning budgetary adjustment (linked to domestic political factors) and by changes in the climate in international markets.[20]

A gradualist strategy was followed in periods of decreasing interest rates (as in 1993, in the wake of the 1992 exchange rate crisis, and in 1996), deploying both liquidity control and the official rates, albeit to different extent. The official rates were reduced cautiously in order to ensure

20 "Between late February and mid-April the lira suffered a further sharp depreciation owing to tensions in the foreign exchange markets and domestic political uncertainty; there was a simultaneous increase in yields of government securities. The Bank of Italy progressively tightened monetary conditions by limiting the supply of liquidity on offer at auctions of repurchase agreements. Allotment rates for Bank of Italy repos and overnight rates rose above the rate on fixed-term advances" (Banca d'Italia, Economic Bulletin No. 21, October 1995, p. 44). In the second half of October, "liquidity control was tightened in response to a heightening of tension in the financial and foreign exchange markets; repo allotment rates rose to around 10.9% for a few days, thus exceeding the rate on fixed-term advances" (Banca d'Italia, Economic Bulletin No. 22, February 1996, p. 48).

that the easing would not be interpreted as a relaxation of anti-inflationary resolve.[21] The movement of repo rates sometimes anticipated the adjustment of official rates (as in the first part of 1993 and the first half of 1996), and sometimes followed it (as in the last part of 1993).

2. Different degrees of flexibility and visibility in interest rate management

Interest rates that exhibit different degrees of flexibility and visibility are also found in the other major European countries that use some kind of interest rate "corridor", including an upper and lower limit (either posted rates on standing facilities, as in Germany, or repo rates, as in France) and a more flexible rate, controlled by the central bank in ways that depend on country-specific characteristics. While in Italy the latter is determined via variable-rate auctions and thus to some extent reflects market conditions, it may be more strictly controlled by the central bank (sometimes determined with fixed-rate operations) or be a market rate (such as the overnight rate), which is only indirectly influenced by the supply of liquidity.

The presence of an interest rate corridor often is the result of very different country-specific institutional developments: in Italy, the configuration of monetary policy rates depicted in Figures 2a and 2b is not the deliberate project of reform, but the *de facto* consequence of a number of institutional changes in the previous years.[22] In all these countries, however, both the official rates and the repo rate (or its equivalent) appear to play a role in the transmission of monetary policy and seem to be regarded by the markets as measures of monetary policy. In this sense, there are "many" policy rates.[23]

The situation in some other countries is different. The distinction between short-term interventions and the longer-term policy stance may be blurred when the central bank is almost continuously present in the market (for instance, in the absence of reserve requirements with averaging provisions, as in the United Kingdom), or official rates may have little impact in determining market yields, as in the United States where, according to most interpretations, the

21 In 1993, it was felt that a large, immediate cut in official interest rates "would have generated fear of laxity in monetary management, impeding the restoration of confidence and a lasting reduction in long-term market rates." (Banca d'Italia, *Economic Bulletin* No. 16, February 1993, p. 38). In this period "open market operations kept very short-term interbank rates close to the discount rate in the first half of the year, pushing them up towards the rate on fixed-term advances from the summer onwards with the reappearance of pronounced exchange rate instability" (Banca d'Italia, *Economic Bulletin* No. 17, October 1993, p. 47). In 1996, while the improved outlook for inflation and inflation expectations allowed an easing of monetary policy, the need remained to "completely eradicate the expectations of a resurgence of inflation", as was stated by Governor Fazio. Liquidity policy and official rate changes were both used: in the first part of the year monetary policy allowed a decrease in short-term market rates, while maintaining the underlying orientation unchanged, as was shown by the level of the official rates; these were reduced only in July.

22 The introduction of repo operations as a way to manage liquidity, in the 1980s, coincided to a large extent with the move to indirect monetary control. The introduction of an averaging system for required reserves was aimed at giving stability to very short-term rates and allowing a larger use of short-term interbank rates as an operating target for monetary policy, giving the banks more flexibility in managing their liquidity and fostering the development of the interbank market. The change in the mechanism for setting the rate on fixed-term advances was aimed at enhancing its role as a monetary policy signal.

23 This is not a necessary conclusion. In principle, an interest rate corridor may simply be used to limit short-term volatility around a central value, thus minimizing the need for interventions. In this case, its role is only to reduce the frequency of intervention by the central bank, distinguishing monetary policy interventions (aimed at determining the interest rate "within" the corridor) from merely technical ones (thanks to the averaging of the reserve requirements and to the limits on excessive fluctuations of market rates).

federal funds rate is the main monetary policy signal and the discount rate plays a much lesser role.[24] In some countries official rates are simply linked to market rates through an indexation mechanism.

The differentiation of policy rate roles responds to the need to disentangle the effect on liquidity costs from that on market expectations. Angeloni (1994b) describes the model prevailing in continental Europe, emphasising a mixture of rigidity and a margin for flexibility, which performs the twofold function of sending clear medium-term signals to the market, through official rates, while also reacting to unexpected tensions in the short run, especially on the currency market, through liquidity management. Sanz and Val (1993) also emphasise the need to distinguish between short-term tightening and signalling the medium-term monetary policy stance. Commenting on the introduction of securities repos in Germany, Issing (1994) mentions the need to respond promptly and in a differentiated way to changing money market conditions. In the current debate on policy procedures in Europe, Jensen (1996) sees interest rates on deposit and loan facilities as the instrument for sending strong signals on the medium-term orientation, while the stance of monetary policy can be gradually adjusted via the repo rate.

In the economic literature, a call for very timely, visible and discrete moves in the policy rates stems from models in which price stability is the only concern and monetary policy works mainly through expectations. According to Goodhart (1996), with a price target, official rates should be moved in discrete steps as soon as "news" arrives; otherwise, monetary policy is always "too little, too late" and loses effectiveness. Cukierman and Meltzer (1986a) also argue that, with a single target, a noisy signal may diminish the credibility of the central bank, or make it more difficult to achieve.[25]

However, other reasons may suggest moving interest rates in a gradual way and limiting the visibility of the policy signal. Goodhart (1996) explains the observed tendency of central banks to "smooth" movements in interest rates[26] by positing some additional objective, such as avoiding interest rate reversals, which may give an impression of uncertainty and indecision (Rudebusch (1995) also cites this as a reason for gradualism). This concern may be particularly important when the central bank has imperfect knowledge of the nature and persistence of the shocks hitting the economy and time is needed to improve its understanding. The desire not to unsettle financial markets may also be a constraint: the possibility of market overreaction to policy changes may make central banks increasingly concerned about how an interest rate adjustment is perceived (sometimes, the importance attached to market reactions may even delay a decision until the need for the move is more clearly perceived by outside observers).[27] Similar arguments have been advanced for limiting the visibility of the signals sent to the market: the fear that financial markets may overreact to policy rate changes is considered a reason for the Fed's secrecy by Dotsey (1987) and Goodfriend (1986).[28] If there are many

24 The federal funds rate target has been considered the relevant policy rate in most recent papers on the Fed's conduct (see for instance Goodfriend (1993), Radecki and Reinhart (1994), Roley and Sellon (1995) and Rudebusch (1995)).

25 The view that a clear communication of the central bank's intentions concerning interest rates is more credible and more effective in affecting inflation expectations and longer-term rates is implicit in a number of positions expressed by central bankers. According to Rudebusch (1995), this is why, for instance, the Fed's management of interest rates features stability over the medium term. In this regard, Goodfriend (1991) notices that the transmission of monetary policy to output and prices does not respond directly to movements in the federal funds rate, but rather to rates at longer maturities (at least three or six months); since these rates depend on market expectations of future fund rates, by maintaining an expected constancy of the latter for some months, the Fed can influence longer-term rates and eventually its final objectives.

26 Rudebusch (1995) shows that this is the case for the federal funds rate target: there is a high probability that a movement will be followed by another movement in the same direction. Goodhart (1996) extends this finding to other central banks.

27 See Bisignano (1995). Since the central bank often has superior information on future inflation, as shown by Romer and Romer (1996), an increase in official rates may be perceived as disclosing information that inflationary pressures are worse than previously expected and lead to a pessimistic reaction by the market.

28 The view that secrecy reduces the variability of market rates is questioned by Tabellini (1987).

targets, together with frequently changing "preferences" in the objective function, an optimal level of secrecy exists, according to Cukierman and Meltzer (1986b).[29]

The model observed in continental Europe may be seen as the choice of an optimal trade-off between these two tactics, using interest rates with different flexibility and signalling content.

The signalling role of different policy rates, however, is not a given. It depends on how they are managed and the consistency of this behaviour over time. According to Goodhart and Viñals (1994), it is not self-evident that rates on standing facilities would do a better job than open market operations in signalling monetary policy intentions. A provocative position is taken by King (1994), who notes that monetary policy signalling need not be linked to liquidity provision at all and that it could be achieved "by hoisting a flag from the top of the Bank, or by speeches by the Governor" or, in a more sophisticated way, by assigning probabilities to future policy outcomes. According to the Deutsche Bundesbank (1994) the use of repo operations in Germany, although generally successful, has only in part fulfilled "the hopes of being able to act more "discreetly" with the aid of the more flexible money market management techniques", as "particularly in the case of securities repurchase agreements, the general public has sometimes attached a significance which was not nearly warranted to marginal changes in allotment rates".

This raises two questions: whether this approach to monetary tactics is successful in fine-tuning monetary transmission, at least in the short run; and what the relevant monetary policy indicator is over longer periods.

3. The transmission of monetary policy

According to the interpretations outlined above, all the policy interest rates – both the official rates, directly set by the Bank of Italy, and the repo rates, affected by liquidity policy – are effective in transmitting monetary policy, but their effects should be different. Official rates are assumed to have greater impact on the expectations of the public and thus on longer-term segments of the yield curve. Repo rates are thought to influence mostly the shorter-term segment of interest rates and to be transmitted more slowly to market expectations, credit conditions and spending decisions.

In this section, we test the validity of these assumptions. In particular, we test for differential effects of the repo rate and of the "average official rate"[30] of the Bank of Italy through: (i) the whole structure of interest rates; (ii) survey-based measures of expectations of different sectors of the economy.

The market interest rates considered are bank deposit and lending rates, eurolira money market rates and medium and long-term swap rates. The estimation is based on reduced-form equations, linking each dependent variable to its own lags and to contemporaneous and lagged values of the two policy rates. The estimation is conducted for the period 1991-95, when the changes in the operating procedures of the Bank of Italy became effective, well-developed markets for medium and long-term securities existed and high-frequency data on market yields were available. For bank rates, we used averages computed over ten-day periods (the greatest available frequency in banking statistics); for money-market and medium and long-term yields, end-of-week data were used. Survey

29 Another important reason for sending a less explicit signal about the level of the interest rate is sometimes linked to the need to diminish outside pressure on the central bank (hence allowing more independent behaviour). According to Goodfriend (1993), the adoption of quantity, rather than interest rate, targets in the 1979-82 period in the United States was mostly motivated by this need (while the Fed was actually still looking at interest rates as operating targets).

30 I.e., the arithmetic mean between the discount rate and the fixed-term advance rate. We do not distinguish the effect of the two official rates, as they have been almost collinear in the estimation period (the spread changed only five times and has been between 1 and 1.5 percentage points for most of the period).

data refer to the inflationary expectations measured quarterly by Forum-Mondo Economico and to the Index of Consumer Confidence derived from a monthly survey of households, based on recent work by Nicoletti (1996) and Locarno and Parigi (1996). These regressions have a longer estimation period, starting in 1972 for the Forum-Mondo Economico survey ~~and~~ 1982 for the Index of Consumer Confidence. [31]

Table 3

Monetary policy rates and monetary transmission[1]

Endogenous variable	**Hypothesis[2]**			**Impact effect[3]**			**Steady State effect[3]**		
	exclusion of repo rate	exclusion of official rate	official-repo rates have same effect	official rate[4] (+) (-)	repo rate	*GER* rate	official rate	repo rate	*GER* rate
Bank rates									
Checking	[16%]	[0%] **	[0%] **	0.03 0.30	-	-	0.55	-	-
deposit				(1.8) (5.8)			(26.5)		
CDs	[2%] *	[4%] **	[31%]	0.15	0.05	-	-	1.0	-
				(2.6)	(2.5)			(12.2)	
Average lending	[0%] **	[0%] **	[0%] **	0.37 0.12	0.05	-	-	0.9	-
				(5.9) (2.1)	(3.1)			(31.3)	
Minimum	[0%] **	[5%] *	[4%]*	0.06	0.03	-	-	0.8	-
lending				(1.1)	(1.4)			(33.0)	
Money market rates									
3-month	[0%] **	[0%] **	[16%]	0.35	0.65	0.80	-	1.04	-
				(1.6)	(5.3)	(4.7)		(16.8)	
6-month	[0%] **	[0%] **	[0%] **	0.46	0.39	1.73	-	0.95	-
				(2.4)	(3.3)	(4.9)		(8.7)	
1-year	[0%] **	[0%] **	[0%] **	0.49	0.31	1.52	-	0.83	-
				(3.4)	(3.3)	(5.3)		(4.2)	
Medium to long-term rates									
3-year swap	[6%]	[0%] **	[0%] **	0.39	0.07	1.01	-	-	0.83
				(9.6)	(1.1)	(6.6)			(1.4)
5-year swap	[32%]	[0%] **	[0%] **	0.35	-	1.06	-	-	1.25
				(4.3)		(6.0)			(2.2)
10-year swap	[45%]	[0%] **	[0%] **	0.28	-	1.22	-	-	1.8
				(8.0)		(6.4)			(2.7)
Survey expectations									
Consumer	[58%]	[1%] *	[4%] *	-0.20	-		-0.05	-	
confidence				(2.9)			(2.5)		
Inflation	[84%]	[2%] *	[13%]	-0.10	-		-	-	
expectations				(2.3)					

[1] OLS estimates; sample periods and full specification of the equation estimated are described in Tables 4 to 8. Average ten-day data for bank rates (1992-95); end-of-week data for market rates (1992-95); monthly data for consumer confidence (1982-94); quarterly data for inflation expectations (1972-95). [2] χ^2 test: p-values in square brackets. (*) and (**) indicate rejection of the null hypothesis at 5% and 1% confidence level, respectively. [3] t-statistics in parenthesis. [4] (+) ≡ rises; (-) ≡ cuts.

31 Since a uniform rate on fixed-term advances did not exist until 1991, we used the discount rate in these regressions instead of the "average official rate".

The inclusion of contemporaneous values of the repo rates in the regressions requires them to be weakly exogenous with respect to the dependent variable. As described in Section 1, repo rates are affected not only by the supply policy of the Bank of Italy, but also by demand behaviour. Since the maturity of most repo operations is between 10 and 20 days, shifts in market expectations may cause simultaneous movements in both market and repo rates. In order to isolate the movements due to policy actions only and to ensure the consistency of the estimation, we used an instrumental variable approach, choosing as instruments the two liquidity indices discussed in Section 1 and various lags of the repo rate.

A summary of the results is given in Table 3, while details of the regressions are shown in Tables 4 to 8. The first and second column of Table 3 report the test for the exclusion of the repo rate and the official rate, respectively, verifying whether each rate has additional explanatory power with respect to the other in explaining the endogenous variables considered. The third column reports the tests of the hypothesis that the two rates have the same effect – both dynamically and in equilibrium – on the dependent variable;[32] this assumption is equivalent to testing whether only one policy rate matters for monetary policy transmission. As the table shows, all these hypotheses are usually rejected, indicating that both policy rates matter and that their effects are different. The main exceptions are the effects of the two policy rates on the shorter money-market rates, which are quite similar, and the absence of any effect of repo rates on medium and long-term yields and on survey expectations, which are only affected by official rates.

The last portion of the table compares the impact and steady-state coefficients of the two policy rates. While official rate changes tend to have a stronger immediate effect, accelerating the adjustment, repo rates determine the steady-state value to which market rates tend, at least as far as bank rates and short-term yields are concerned.

All in all, the management of policy rates seems to have been successful in fine-tuning the short-run effects of monetary policy, disentangling the expectations effect from the effect on liquidity conditions. Over the longer run, however, "fundamentals" matter, and the actual cost of banks' liquidity (i.e., the repo rate) is the appropriate measure of the effect of monetary policy on market yields.

3.1 Bank rates

We consider two deposit rates (on checking accounts and 6-month CDs) and two lending rates (the average and the minimum lending rates).[33]

The estimated equation for each rate is written in error-correction form:[34]

$$\Delta BR = \alpha_1 \Delta OFF_t^{+} + \alpha_2 \Delta OFF_t^{-} + \alpha_3 \Delta REPO_t + \alpha_4 \Delta BR_t + \beta_1 OFF_{t-1} + \beta_2 REPO_{t-1} + \beta_3 BR_{t-1}$$

where BR is the bank rate, $REPO$ the repo rate and OFF the official rate. The suffixes "+" and "–" on official rate changes denote positive and negative variations. This choice follows the empirical literature on bank rates in Italy, which has found an asymmetric effect of official rate changes in the

32 This assumption imposes the restriction that in each equation both the impact and the steady-state coefficients of the official rate are equal to the corresponding coefficients of the repo rate.

33 All rates are from ten-day banking statistics. The lending rate is the average rate on overdrafts and short-term loans of a sample of banks accounting for about 90% of total lending. Short-term credit in Italy represents about 50% of total bank credit. The minimum lending rate is defined as the first decile of the distribution of interest rates.

34 The specification search started from a model with more lags; the final form was selected by deleting the lags that were not statistically significant.

past; this feature was usually explained by reference to oligopolistic price setting behaviour for both deposits and loans.[35]

As is shown in Table 4, changes in the official rate usually have a larger impact on bank rates than changes in the repo rate; this is not the case, though, for instruments traded on more competitive markets (CDs; loans to the "best" customers). Similarly, the existence of an asymmetric effect of official rate changes is rejected for the CD rate and the minimum lending rate. Overall, the immediate effect of a 100 basis point rise in official rates on the various bank rates is between 3 and 30 basis points; the impact of changes in the repo rate ranges between 3 and 5 basis points. Structural forms estimated by other authors found stickiness in the adjustment of bank rates to market rates;[36] a comparison of our results with those obtained for previous sample periods suggests that there was a reduction in the stickiness of bank rates in the 1990s (an increase in the effect of the repo rate and in the speed of adjustment over the following months).[37] These changes reflect the increase in competition in deposit and to a larger extent in credit markets that has been under way since the second half of the 1980s.

Table 4
Bank rates*

Δ dependent	Checking deposit rate	6- month CDs rate	Average loan rate	Minimum loan rate
Constant	-0.10 (3.5)	-0.02 (0.7)	0.29 (3.9)	0.22 (3.7)
$\Delta dependent_{t-1}$	0.20 (2.8)	0.44 (5.7)	0.13 (2.2)	–
ΔOFF^{+}	0.03 (1.8)	–	0.37 (5.9)	–
ΔOFF	–	0.15 (2.6)	–	0.06 (1.1)
ΔOFF_t^{-}	0.30 (5.8)	–	0.12 (2.1)	–
$\Delta REPO_t$	–	0.05 (2.5)	0.05 (3.1)	0.03 (1.4)
$dependent_{t-1}$	-0.11 (6.1)	-0.04 (2.9)	-0.09 (6.1)	-0.13 (8.9)
OFF_{t-1}	0.06 (6.5)	–	–	–
$REPO_{t-1}$	–	0.04 (3.1)	0.08 (6.1)	0.11 (8.8)
$\bar{R}^2$	0.66	0.72	0.73	0.67
S.E. of regression	0.05	0.07	0.09	0.08
D.W	2.1	2.15	2.10	2.1
Autocorrelation	[53%]	[16%]	[5%]	[6%]

* OLS estimates. White's t-statistics in parenthesis. Confidence levels in square brackets. Sample: 1st January 1992-10th January 1996; average ten-day data.

35 Decreases are usually found to have a stronger effect on deposit rates than increases (the opposite holds for lending rates). See Angeloni (1994a).

36 See, for instance, Angeloni (1994a); Cottarelli, Ferri and Generale (1995).

37 In our regressions, Chow-tests reject the hypothesis of no change between the 1985-91 period and the 1992-95 period.

In the steady-state solution, bank rates converge to the repo rate (except for checking accounts); this is also consistent with earlier findings of a long-run elasticity to money market rates of about one. Overall, our results are consistent with the hypothesis that in the long run it is the actual cost of refinancing – the repo rate – that matters. The stronger impact effect of the official rate reflects its "signalling" content, which eventually vanishes if the effective cost of liquidity does not follow. Correspondingly, changes in repo rates do eventually affect bank rates even without official rate changes, although more slowly.

Table 5
Money market rates*

Independent	3-month rate	6-month rate	1-year rate
Constant	-0.02	0.15	0.17
	(0.1)	(1.4)	(1.4)
$\Delta dependent_{t-1}$	-0.68	-0.56	-0.54
	(6.5)	(4.9)	(2.6)
ΔOFF_{t+1}	0.20	0.25	0.28
	(3.0)	(4.4)	(5.1)
ΔOFF_t	0.15	0.21	0.21
	(0.8)	(1.5)	(1.6)
ΔOFF_{t-1}	0.34	0.33	0.32
	(2.35)	(2.1)	(2.1)
$\Delta REPO$	0.65	0.39	0.31
	(5.3)	(3.3)	(3.3)
$\Delta REPO_{t-1}$	0.46	0.30	0.13
	(9.6)	(5.9)	(4.9)
ΔGER_t	0.16	1.37	0.49
	(0.8)	(3.4)	(4.1)
ΔGER_{t-1}	0.63	0.36	1.03
	(2.4)	(1.8)	(3.4)
$dependent_{t-1}$	-0.23	-0.12	-0.06
	(4.1)	(3.8)	(3.1)
OFF_{t-1}	–	–	–
$REPO_{t-2}$	0.24	0.11	0.05
	(3.5)	(2.9)	(2.2)
$\bar{R}^2$	0.58	0.56	0.43
S.E. of regression	0.43	0.36	0.32
D.W	2.1	2.0	1.8
Autocorrelation	[5.2%]	[94%]	[6%]

* Instrumental Variables estimates. Newey-West's t-statistics in parenthesis. Confidence levels in square brackets. Sample: 30th week 1991-52nd week 1995; end-of-week data.

3.2 Money market rates

We considered interest rates on lira-denominated euro-deposits for maturities of 3, 6 and 12 months. After the specification search, the estimated equation was:

$$\Delta MM_t = \alpha_0 + \sum_{i=-1}^{1} \alpha_{1i} \Delta OFF_{t-i} + \sum_{i=0}^{1} \alpha_{2i} \Delta REPO_{t-i} + \sum_{i=0}^{1} \alpha_{3i} \Delta GER_{t-i} + \alpha_4 \Delta MM_{t-i} + \beta_1 REPO_{t-2} + \beta_2 MM_{t-1}$$

where MM is the money market rate and GER is the rate on corresponding Deutsche mark-denominated euro-deposits. The latter is included in differences.[38] We also included one lead of the change in the official rate. This specification, used in some of the literature on the effects of policy rates,[39] takes account of the fact that when official rate changes are anticipated, part of their effect may be embodied in market rates in the days immediately preceding the change, so that the contemporaneous and lagged coefficients may underestimate the total effect.

The results show that both policy rates affect short-term market yields; unlike the previous case, their impact effects are quite similar. A change in the official rate has a contemporaneous effect on money market rates of about 0.4 on average, increasing from 0.35 on 3-month yields to 0.49 on 12-month yields; the effect of the repo rate is similar, although decreasing with maturity, from 0.65 on 3-month yields to 0.31 on 12-month yields (Tables 3 and 5). In the steady-state solution, point estimates suggest that the level of the repo rate has a coefficient of one. This implies that in the long-run market rates are also determined by the actual cost of refinancing with the central bank.

3.3 Medium and long-term yields

For medium and long-term yields, we considered 3, 5 and 10-year swap rates on the euro-market. The general form of the equation is similar to that in the preceding section. However, in this case the specification search suggested also including the level of German yields on corresponding maturities and selecting an equation of the following form:

$$\Delta ML_t = \alpha_0 + \sum_{i=-1}^{0} \alpha_{1i} \Delta OFF_{t-i} + \alpha_2 \Delta REPO + \alpha_3 \Delta GER_{t-i} + \beta_1 GER_{t-1} + \beta_2 ML_{t-1}$$

where ML is a generic medium or long-term rate. The results show that while the effect of the repo rate is almost negligible, changes in the official rate display a significant effect on interest rates on these segments (Tables 3 and 6). This is consistent with the findings of Buttiglione et al. (1996) and offers evidence in favour of the expected persistence of changes in the official rates and of their larger signalling content.

Furthermore, the difference between short-run dynamics and the steady-state solution is larger than in the case of bank rates or short-term yields. Though official rate changes do affect the adjustment of market rates, they do not enter the final equilibrium in a statistically significant way. The long-run solution, rather, is characterised by a convergence of the domestic rate to the corresponding German yield. This result is consistent with other findings on Italian and international rates. Fell (1996) finds that, in many industrial countries in the course of the 1980s and the 1990s, long-term rates were increasingly responsive to international yields rather than to domestic short-term rates. He argues that a steady-state solution implying convergence of nominal rates may be satisfactory as long as the expected inflation differential is a stationary process.

The results may suffer from the omission of a relevant variable, the expected inflation differential, which is quite difficult to measure in general, let alone on weekly data. However, a similar result for the steady-state solution for 10-year Italian Treasury bond rates is obtained on quarterly data by Gaiotti and Nicoletti (1996); they find that domestic yields converge to foreign ones, augmented by a proxy for the expected inflation differential and a risk premium.

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38 The specification search rejected the inclusion of the level of the DM rate in the equation.

39 Cook and Hahn (1984), Dale (1993), Radecki and Reinhart (1994), Roley and Sellon (1995) and Buttiglione et al. (1996) consider a time interval around the day of the policy rate change.

Table 6
Medium and long-term yields*

Independent:	3-year rate (IV)	5-year rate (OLS)	10-year rate (OLS)
Constant	0.10	0.06	-0.05
	(1.2)	(0.5)	(0.4)
ΔOFF_{t+1}	0.17	0.15	0.12
	(4.0)	(4.2)	(3.9)
ΔOFF_t	0.22	0.19	0.17
	(3.2)	(3.9)	(4.2)
$\Delta REPO_t$	0.07	–	–
	(1.1)		
ΔGER_t	0.01	1.06	1.22
	(6.6)	(6.0)	(6.4)
$dependent_{t-1}$	-0.015	-0.019	-0.026
	(2.2)	(2.2)	(2.1)
OFF_{t-1}	–	–	–
$REPO_{t-1}$	–	–	–
GER_{t-1}	0.013	0.024	0.048
	(1.4)	(1.9)	(2.0)
$\bar{R}^2$	0.30	0.30	0.31
S.E. of regression	0.23	0.21	0.19
D.W	2.1	2.1	2.1
Autocorrelation	[33%]	[50%]	[60%]

* Instrumental Variables (IV) and OLS estimates. Newey-West's t-statistics in parenthesis. Confidence levels in square brackets. Sample: 30th week 1991-52nd week 1995; end-of-week data.

3.4 Survey-based measures of expectations

The significance of the impact of official rate changes on market expectations is confirmed by tests based on measures of expectations other than those implicit in the yield curve. Nicoletti (1996) and Locarno and Parigi (1996), working on survey data, showed respectively that discount rate increases do contribute to a downward revision of inflationary expectations and to a decrease in consumer confidence. Both these variables play a role in monetary transmission: inflationary expectations affect the determination of wages (and may also contribute to the short-run dynamics of prices, for a given rate of wage growth); consumer confidence contributes to explaining consumption behaviour.[40]

Since the expectations measured by the survey data are not (or not only) expressed by financial operators, but refer to a composite sample in the first case and to households only in the second, the distinction between the highly visible discount rate, widely commented in the press, and the yield on more technical operations like the repos should be quite important.

40 See Gaiotti and Nicoletti (1996); Locarno and Parigi (1996).

Table 7
Inflation expectations*

Independent	Dependent: $\pi_{t/t-1} - \pi_{t-1/t-2}$		
$DU84 * \Delta DISC_{t-1}$	-0.11 (2.3)	–	-0.09 (1.6)
$DU84 * \Delta REPO_{t-1}$	–	-0.03 (1.2)	-0.01 (0.3)
$\pi^{i}_{t-1} - \pi_{t-1/t-2}$	0.16 (3.3)	0.16 (3.3)	0.16 (3.3)
$\Delta\left(CPU_{t-2} - \overline{CPU}\right)$	0.06 (2.0)	0.06 (2.2)	0.06 (2.0)
DU_{t-2}	-0.19 (2.1)	-0.14 (1.7)	-0.18 (2.0)
$\Delta \dot{e}_{t-2}$	0.02 (2.8)	0.02 (2.8)	0.02 (2.8)
$\Delta\pi^{*}_{t-2}$	0.03 (1.3)	0.03 (1.0)	0.03 (1.2)
$\Delta \dot{pe}_{t-2}$	0.01 (2.8)	0.01 (2.6)	0.01 (2.8)
learning	1.24 (4.4)	1.22 (4.2)	1.24 (4.4)
$learning * \pi_{t-2/t-3}$	-0.45 (5.1)	-0.45 (5.0)	-0.45 (5.1)
R^2	0.54	0.53	0.58
S.E. of regression	0.25	0.26	0.26
D.W.	2.2	2.2	2.2
Autocorrelation	[24%]	[21%]	[23%]
Normality	[71%]	[79%]	[72%]
Heteroschedasticity	[62%]	[94%]	[67%]

* OLS estimates. White's t-statistics in brackets; confidence levels in square brackets. *U*: unemployment rate; *e*: rate of change of the effective exchange rate; *pe*: rate of change in energy prices; $CPU - \overline{CPU}$: divergence of the capacity utilisation rate from its normal value; $p_{t+1/t}$: one quarter-ahead CPI inflation expected at *t* (*Forum-ME* survey data, at annual rate); p^*: weighted rate of change of average prices in 14 of Italy's trading partners; *DISC*: official discount rate; *REPO*: rate on securities repurchase agreements with the Bank of Italy. *DU*84 is a dummy that takes a value of 1 after 1984. *DU*84 = dummy variable equal to 1 after 1984, "*learning*" is an adjustment variable, originally estimated with transition function technique (see Nicoletti (1996)). Sample: 1st quarter 1972-4th quarter 1995; quarterly data.

The dependent variable in the first equation is the one-quarter-ahead inflationary expectation measured by the Forum-Mondo Economico survey.[41] Apart from the policy rate, explanatory variables include past inflation, the capacity utilisation rate, the unemployment rate, the exchange rate, prices of foreign competitors and energy prices. As is shown in the first column of

41 The Forum-Mondo Economico survey of Italian experts from different sectors has been conducted since 1952. See Visco (1984).

Table 7, discount rate changes have had a significant effect on inflationary expectations since 1984.[42] This result is probably related to the transition to indirect controls after 1983. The other two columns of the table show the results obtained by running the same regression with the repo rate, either added to the discount rate or substituted for it. This rate has no additional explanatory power in the equation and substituting the discount rate with the repo rate does not yield a significant coefficient.

Table 8
Consumer confidence*

Independent	**Dependent: log (*ICS*)**		
constant	1.21 (4.1)	0.94 (3.5)	1.17 (4.0)
$\log(ICS_{t-1})$	0.59 (7.2)	0.63 (7.6)	0.59 (7.3)
$\Delta DISC$	-0.17 (2.8)	–	-0.21 (2.9)
$\Delta REPO$	–	0.01 (0.2)	-0.03 (1.1)
$DISC_{t-1}$	-0.05 (3.2)	–	-0.06 (2.5)
$REPO_{t-1}$	–	-0.03 (1.6)	0.04 (0.2)
$\log(ICS_{t-2})$	0.30 (3.7)	0.25 (3.0)	0.32 (3.7)
$(\Delta U + INFL)$	-0.03 (3.3)	-0.04 (3.7)	-0.03 (3.2)
$\Delta EXCH_t$	-0.59 (5.6)	-0.62 (5.4)	-0.59 (5.7)
$EXCH_t$	-0.09 (3.2)	-0.04 (1.9)	-0.09 (3.1)
$\Delta INDPROD$	0.43 (2.9)	0.50 (3.7)	0.46 (2.9)
$PCYCLE$	-0.01 (2.4)	-0.01 (2.1)	-0.01 (2.3)
R^2	0.95	0.95	0.95
S.E. of regression	0.018	0.019	0.019
D.W.	2.0	2.0	2.0
Autocorrelation	[75%]	[45%]	[68%]
Normality	[6%]	[8%]	[6%]
Heteroschedasticity	[35%]	[30%]	[36%]

* OLS estimates. White's t-statistics in parenthesis; confidence levels in square brackets. *ICS*: Index of Consumer Sentiment; *U*: unemployment rate; *INFL*; inflation rate, based on the cost of living index; *EXCH*: lira/DM exchange rate; *INDPROD*: index of industrial production; *PCYCLE*: dummy for periods of government crises. Sample: March 1982-December 1994; monthly data.

42 Nicoletti (1996) originally estimated the equation with variable coefficient techniques, identifying both an adjustment effect (which he calls a "learning" process) following the inflation volatility of the seventies, and a jump in the monetary policy coefficient in 1984. In our estimation, we included a dummy variable (with value one after 1984) and a learning variable reproducing the one he estimated.

As to consumer confidence, the effects of monetary policy rates on the Index of Consumer Confidence, based on a survey on households conducted every month since 1982,[43] are analysed. The first column of Table 8 reports the estimates of a regression of the index on the discount rate and some macro-variables (the inflation rate, the unemployment rate, the exchange rate, real disposable income and a variable that captures the effects of political events, given by a dummy variable for periods of cabinet crisis)[44]: a one-point increase in the discount rate worsens consumer confidence (the index decreases by about 20%). The other two columns of the table show that this effect disappears if monetary policy is measured by the repo rate. Even when both the repo and the discount rates are included among the explanatory variables, the former has no additional explanatory power.

Conclusions

The conduct of monetary policy in Italy hinges both on the direct setting of official rates and on liquidity control, which in turn affects the interest rate on the central bank's securities repurchase agreements. Both these instruments have been used in recent years, with the twofold purpose of affecting long-term inflationary expectations, due to their primary role in monetary transmission, and responding more flexibly to recurrent, if often transient, exchange rate tensions and worsening of expectations regarding adjustment of the public finance. The literature offers reasons for the choice of different policy rates and for either very transparent, discrete and persistent interest rate movements or more gradual, flexible and less immediately visible ones.

We have tested some implications of these procedures for the monetary policy transmission process in Italy, finding that the rate on repos and the official rate both matter in monetary transmission, but in different ways. The repo rate mostly affects the short-term end of the yield curve and, as it represents the actual cost of banks' refinancing, it forms the value on which market rates and bank rates converge in the long run. The official rate has a much larger role in speeding up dynamic adjustment and in shaping the expectations of non-financial operators.

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43 The index is drawn from the response to nine questions concerning the general economic situation in the last and next twelve months including whether this is a good time to buy durables, expectations about unemployment, the household's economic situation in the last and next twelve months, the household's financial position and the possibility and economic advantage of saving. From 1973 to 1981 the survey was conducted every four months; since 1982, monthly.

44 This basically reproduces unpublished estimates by Locarno and Parigi on a monthly basis. Their 1996 paper reports results on quarterly data and a full description of the equation.

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Operational procedures and tactical approaches of monetary policy in Belgium

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Introduction

The present characteristics of monetary policy in Belgium result from two major decisions. First, in June 1990, the Government committed itself to pegging the Belgian franc firmly to the EMS currencies which are regarded as stability anchors. This linking means that the parity of the Belgian franc against the German mark – whose last modification dates from January 1987 – will not be changed in the event of a realignment within the ERM and that the National Bank of Belgium (NBB) aims at limiting the fluctuations of the franc around this central rate. The widening of the ERM fluctuation margins on 2nd August 1993 did not change Belgium's monetary policy strategy, although the exchange rate objective was pursued with more flexibility in a first stage. Secondly, in January 1991, a monetary reform radically changed the operational framework of monetary policy.

The same strategy – exchange rate targeting – was thus pursued by means of very different operational procedures, before and after January 1991. However, there are some links between the strategy and the operational framework. For example, the central bank has to be able to control short-term interest rates with more precision than within a strategy with medium-term or less precise targets. At the same time, the central bank intends to make this control superfluous, by guiding market expectations. Furthermore, there is no room for monetary base targeting. Finally, the central bank also intervenes in the foreign exchange market; its money market management has, at times, to cope with large swings in liquidity due to these interventions.

Basically the NBB has two categories of instruments at its disposal: interest rate policy and, to some extent, foreign exchange interventions. It implements the interest rate policy through the announcement of its own rates and through its liquidity management.

The first section of this paper describes the operational procedures used in the interest rate policy. The second section analyses the tactical choices made in Belgium in implementing monetary policy.

1 Operational procedures

1.1 The evolution of the operational framework

During the last decades Belgium's monetary policy has moved away from an instrumentarium wherein regulations played an important part, towards a framework with instruments which are in accordance with market mechanisms.

Formally, the NBB still has certain regulatory powers. It is a member of the Board of the Belgian-Luxembourg Foreign Exchange Institute (BLEI), which stipulates the foreign exchange regulations for the Belgian-Luxembourg Economic Union. Also, under the law of 28th December 1973, it can make recommendations concerning monetary policy to the financial intermediaries. These may impose the holding of compulsory reserves, the containment of credit, etc. Nowadays this arsenal of regulations is not used. The two-tier foreign exchange market was abolished in March 1990 and the Foreign Exchange Institute now has only an essentially statistical function. The last monetary policy recommendations were made in 1981 (compulsory holding of public securities on the asset side of the financial intermediaries' balance sheets).

From the middle of the 1970s to January 1991, Belgian interest rate policy relied almost entirely on the discretionary setting by the NBB, in consultation with the Minister of Finance, of the rates on short-term Treasury bills in Belgian francs. Owing to the size of Belgium's short-term government debt, and to the issuing technique (on tap), these monetary procedures proved extremely effective in controlling domestic money market rates.

However, this way of conducting monetary policy exhibited a number of specific characteristics, different from other countries, and which became increasingly serious disadvantages:

- the NBB could not make use of a diversified "instrument mix" in interaction with the money market as most central banks do, but had to rely almost exclusively on one single instrument;[1]
- the instrument of monetary policy, the rate on Treasury bills, was involved in both monetary and budgetary policy;
- the issuing technique applied to Treasury bills, which were only available to resident financial institutions without competition from non-financial enterprises and from non-residents, implied that the Belgian Treasury had to pay an interest rate that was higher than the going interbank rates. This was in contrast to other industrialised countries where Treasury bills are scarce quality investment instruments with returns below other money market rates; and
- by adapting their Treasury bill portfolio, financial intermediaries were able to pass on their possible liquidity shortages or surpluses nearly completely to the Treasury. Hence the assistance which the Bank in principle gave to the money market as a whole, in fact, took the form of assistance to the State and, consequently, could be regarded as monetary financing of the government deficit.

While the system was very efficient in steering money market rates, the structural disadvantages (higher financing costs for the Treasury and the absence of a separation between the central bank and the Treasury) made reform necessary.

The reform, which came into force on 29th January 1991, had two main components: the creation of an efficient market for Treasury bills accessible to a broader range of investors and the adaptation of the operational framework of monetary policy. It has to be seen in the context of broader reforms of the Belgian financial markets at the end of the 1980s and the beginning of the 1990s, which also concerned the government bond market and the stock exchange. These changes were induced by several challenges: the process of European financial integration, the growing internationalisation of financial markets and the need for a more effective management of public debt.

The reform of the instruments of monetary policy attuned Belgian monetary policy to the practices of central banking in the major countries. It constituted an important step in the preparation of the future integration of the NBB in the European System of Central Banks.

A crucial element of the reform was the clearer separation of the responsibilities of monetary and budgetary policy, as the fixing of the interest rates on Treasury bills became the responsibility of the Treasury and no longer of the central bank. Furthermore, the central bank credit to the government became strictly limited to an overdraft facility with a ceiling of BF 15 billion and for the sole purpose of facilitating the Treasury's day-to-day cash management. A new convention between the Minister of Finance and the Bank determined the procedure whereby the NBB must be kept informed of all foreign exchange loans envisaged by the government and whereby the Bank may call for consultation with the Minister of Finance if it considers that such loans are liable to jeopardise the effectiveness of monetary or exchange rate policy.

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[1] In order to enlarge the monetary instrumentarium, a system of periodical allocations of credits by tender was introduced in March 1989.

The Bank's autonomy in the conduct of monetary policy was further confirmed by a provision of the law of 22nd March 1993 concerning the status and supervision of credit institutions, which abolished the right of veto of the Minister of Finance with regard to monetary policy. Another article of that law forbids the financing by the central bank of public authorities and public undertakings other than credit institutions, which had already been considerably limited by the monetary reform of January 1991. An agreement was also concluded in order to avoid excessive fluctuations in the deposit of the State with the Bank.

Since the reform of January 1991, the NBB conducts monetary policy mainly by operations affecting its balance sheet. The Bank influences short-term interest rates by varying the conditions and the quantity of credit it grants to financial institutions.

1.2 Interest rate policy instruments

The operations of the NBB in the money market can be divided into three important categories: provision of structural liquidity to the financial institutions, direct interventions in the money market and the mechanism of daily closing advances and deposits.

1.2.1 Provision of structural liquidity

The Bank has two instruments for the provision of structural liquidity to the financial institutions: a facility for the mobilisation of trade bills and periodical allocations of credit by tender. The main importance of these facilities is that the interest rates applied to them indicate the orientation of the interest rate policy of the Bank.

The facility for the mobilisation of trade bills was introduced on 17th June 1991. Its role consists essentially of giving the NBB the possibility of fixing a discount rate having a symbolic value.[2] This facility is accessible to the financial intermediaries at a privileged rate, but only for limited amounts. Resident credit institutions of the BLEU can mobilise trade bills at any time in the form of repurchase agreements for a period of not less than 15 days and not more than 60 days, for a limited amount of maximum BF 5 billion, with the Rediscount and Guarantee Institute (RGI), which refinances itself at the Bank.

The periodical allocations of credit by tender are usually made "in terms of volume", at a previously announced interest rate which corresponds to the so-called central rate. This is the rate for end-of-day advances and deposits of primary dealers, which can be changed daily. This central rate represents a more precise signal regarding the desired orientation of money market interest rates.[3]

The tender operations, open to all resident credit institutions of the BLEU, are currently organised each Monday, payment by the Bank being made two days later. These lendings have to be covered by collateral: they take, at the choice of the participants, the form of advances against the pledging of public securities or of repurchase agreements in respect of trade bills with the RGI. Presently they are for one week, but the Bank has at times also allocated credit for two, three or four weeks. If the total amount of the tenders – which the Bank can limit up to the credit lines granted to the current account advances – is higher than the Bank considers desirable, it distributes its lending according to a scale fixed during the tender operation.

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2 There was no discount rate at the start of the new system. It appeared useful, however, to have an official rate similar to the Bundesbank's discount rate.

3 Initially, the interest rate on credits by tender indicated the general orientation of the interest rate policy of the Bank. However, as the need arose to indicate changes in interest rate policy between two tenders, the NBB introduced the term "central rate" for the rate for end-of-day advances and deposits of primary dealers (see 1.2.3), which can be changed daily.

The Bank has sometimes also invited credit institutions to tender in terms of both amounts and interest rates. In such cases it can either accept the successful tenders at the single limit rate ("Dutch auction") or accept them at the rates initially proposed by the tenderers ("American auction").

1.2.2 Direct interventions in the money market

By its direct interventions in the money market the National Bank each day influences the liquidity of the financial intermediaries. It modifies primarily the volume of its lending, accepting the most favourable rates offered by the market. In order to fix the volume of its interventions the Bank takes into account, on the one hand, the expected movement of the note circulation and the exchange reserves and, on the other hand, the desired level of strain in the money market – which will be reflected by daily closing surpluses or deficits – depending in the desired orientation of interest rates.

The NBB makes use of a wide range of intervention techniques, which it mostly applies by inviting the "primary dealers" (credit institutions in charge of stimulating the secondary market for public securities) to participate in a quick "American auction". The instruments used by the Bank are:

- "Repurchase agreements" or "repos". These are agreements for the sale and repurchase of securities. This is the type of intervention which is, at present, very frequently used by the Bank. These operations, whereby the Bank buys securities spot and resells them forward – generally only a few days forward – can be likened to fixed-term advances, the period to maturity of the securities serving as collateral being unimportant in this connection. They have no direct effect on the yield of these securities. "Reverse repos" are the same operations, but in the opposite direction. By selling securities spot and repurchasing them forward, the Bank can tighten the cash positions of the financial intermediaries;
- Currency swaps. These spot purchases or sales of foreign currencies against Belgian francs, coupled with forward transactions in the opposite direction, do not modify the exchange rate risk run by the Bank. Like security repos, swaps do not directly influence the prices of the underlying assets, in this case the exchange rate for the Belgian franc;
- Deposits in the interbank market. As these deposits are not secured, the Bank itself sets limits for each individual party concerned. These operations are mostly at one day;
- Outright purchases or sales of securities. Unlike repos, they have a direct influence on the prices of the traded securities.

1.2.3 The mechanism of daily closing advances and deposits

The mechanism of daily closing advances and deposits, even though relatively marginal in terms of outstanding amounts, serves as a support for the effectiveness of the direct interventions in the money market. The central rate and the other rates applicable to closing surpluses and deficits also indicate the orientation of the Bank's interest rate policy.

In order to meet their residual deficits, resident credit institutions of the BLEU may resort to the Bank's current account advances, subject to the provision of collateral. Daily closing surpluses can be deposited with the Rediscount and Guarantee Institute (RGI), which reinvests them at the Bank. The "primary dealers" enjoy a special rate, called central rate, for their advances and deposits up to BF 350 million, that is a total of BF 5.3 billion. Moreover, all resident credit institutions of the BLEU have been granted substantial individual credit lines, totalling BF 220 billion; within these lines, credits are granted at the normal rate for advances, which is above the market rate. An institution which has liquidity requirements in excess of its credit line can obtain advances against pledged security "above the ceiling", at a considerably higher penalty rate. In the same way, deposits with the RGI are remunerated at rates below the central rate. The reduction in the rate is smaller in respect of a first tranche of these deposits, equal to 5% of the above-mentioned credit lines, than on the second tranche, the so-called overstepping tranche.

1.2.4 Structure of official interest rates

All this produces a sort of hierarchy of NBB interest rates (see Table 1). The central rate indicates the orientation of monetary policy. The discount rate and the rate for advances "above the ceiling" are official rates having a symbolic value. The influence of the several other rates on the overnight rate of the money market depends on the way in which the NBB manages liquidity and as such on the volume of the direct interventions in the money market. Thus, the marginal financing cost of the credit institutions corresponds with the central rate when the residual deficit or surplus of the money market is small. It may, however, climb to the rate for ordinary advances should liquidity be tightened.

Table 1
Official interest rates*
In percentages

Rate for current account advances beyond credit lines	6.00
Rate for current account advances within credit lines...................	4.25
Central rate	3.00
Discount rate..	2.50
RGI's rate for daily closing surpluses, ordinary tranche................	2.00
RGI's rate for daily closing surpluses, overstepping tranche..........	1.00

* On 30th September 1996.

1.3 Experience with the new system

The NBB has at its disposal an operational framework which allows it to react quickly to changes in the Bundesbank's interest rates as well as to tensions on the foreign exchange market. The system is characterised by a multiplicity of official rates but some of them have a mainly symbolic function. In fact, the central rate is the key official rate which is usually the most relevant in influencing money market rates: the Bank most often manages liquidity in order to obtain small end-of-day balances. In some circumstances, however, the Bank created large end-of-day deficits in order to drive financial institutions to the Bank's current account advances, thereby exerting a more discreet upward pressure on money market rates.

The system is also characterised by a very active management of money market liquidity, as the targeting of end-of-day balances is part of the policy to influence interest rates. In the absence of any reserve requirement system with averaging provision – which could act as a buffer for liquidity shocks – the Bank intervenes frequently in the money market. This liquidity management implies that money market rates are not automatically influenced by changes in liquidity due to "autonomous factors", such as variations in the demand for banknotes or in NBB's net foreign assets. There will be no volatility of short-term interest rates due to technical factors. In contrast volatility may be accepted for monetary policy reasons, e.g. in case of strains in the foreign exchange market.

The targeting of end-of-day balances requires accurate forecasts of liquidity needs. This poses no major problem within the very-short-time horizon – two days – of liquidity management.

The main "autonomous factors" are changes in net foreign assets and in note circulation (see their volatility in Table 2). Foreign exchange transactions are usually settled with a two-day lag. An econometric forecast of the demand for banknotes is made, the standard error of which is around BF 0.6 billion. As regards the deposits of the Belgian State and the Luxembourg State,[4] two agreements were signed in 1993 with a view to avoiding unexpected changes: a ceiling is imposed on the deposits (BF 15 billion for the Belgian State, BF 0.5 billion for the Luxembourg State); the Belgian Treasury has to communicate its forecasts, and differences between realised and foreseen amounts exceeding BF 2 billion are penalised; movements in the deposit of the Luxembourg State have to be notified two days in advance.

Table 2
Transactions of the National Bank of Belgium
In billions of Belgian francs

	Average outstanding amount		Standard deviation of daily variations	
	1994	1995	1994	1995
1. Autonomous factors	-87.4	38.2	5.0	6.2
1.1 Note circulation (-)	-424.8	-410.9	2.7	2.8
1.2 Net foreign assets*	328.7	439.7	4.1	5.5
1.3 Deposit of the Belgian State (-)	-1.7	-1.4	1.2	1.0
1.4 Deposit of the Luxembourg State (-)	-0.5	-0.1	0.0	0.1
1.5 Miscellaneous net assets	10.9	10.9	1.5	1.2
2. Regulation of the money market by the NBB	87.4	-38.2	5.0	6.2
2.1 Restrictive currency swaps (-)	-60.7	-175.2	4.2	5.4
2.2 Structural liquidity assistance	28.8	17.6	4.1	2.4
2.2.1 Trade bills	3.9	2.6	0.1	0.0
2.2.2 Credits granted by tenders	24.9	14.9	4.1	2.4
2.3 Other direct interventions in the money market (net)	118.2	117.1	7.0	5.4
2.3.1 Securities purchased in the market	27.4	21.8	1.3	0.7
2.3.2 Very-short-term repurchase agreements	89.7	94.5	7.1	5.8
2.3.3 Enlarging currency swaps	0.1	0.0	1.3	0.4
2.3.4 Interbank deposits or loans (-)	1.1	0.8	2.7	2.5
2.4 Coverage or absorption (-) of residual money market balances	1.1	2.3	4.6	3.4
2.4.1 Current account advances	3.1	4.2	4.3	3.0
2.4.2 Daily closing surpluses (-)	-2.0	-1.9	1.2	1.0

* At historical cost and before currency swaps.

Another agreement between the NBB and the Belgian State relates to the exchange of information about the foreign currency debt of the Kingdom. Variations in this debt are often used as a device for sterilising the liquidity effects of foreign exchange interventions made by the Bank. Since

4 According to the law of 22nd March 1993, public entities have no access to central bank credit.

1992 the NBB has purchased large amounts of foreign currencies. Part of these were sold to the Treasury in order to reimburse part of its foreign currency debt.

Nevertheless this was not sufficient to sterilise the liquidity effects of interventions in the foreign exchange market, which threatened to flood the money market. The Bank has made extensive use of restrictive currency swaps to keep the money market "en Banque".

Foreign currency swaps are frequently used to offset the effect of interventions, but they are not considered as "active" monetary policy instruments. Indeed, like other central banks, the Bank has a preference for conducting monetary policy through operations registered at the asset side of its balance sheet.

In contrast, central bank credits are explicitly used to steer money market rates. The Bank prefers to give mainly short-term credits to financial intermediaries in order to keep the money market well under control. Structural liquidity assistance is not so important. Mobilisation of trade bills and credits granted by tender amounted to BF 3 and 15 billion respectively, on average, in 1995, compared to BF 117 billion for credits granted through direct interventions in the money market.[5] Most of these direct interventions take the form of very-short-term repurchase agreements, which amounted to BF 95 billion in 1995. These repos are very actively used by the Bank in its management of the money market, as is also apparent in the high standard deviation of their daily variations. The portfolio of Treasury bills amounted to BF 22 billion but was fairly stable. The size of the NBB's balance sheet leaves no room for significant transactions in the bond market.

Finally, it can be observed that end-of-day deposits are very small when there is an overall deficit and that current account advances are very small when there is an overall surplus. The start of the real time gross settlement system ELLIPS on 24th September 1996 did not modify this feature, which is probably the sign of an efficient functioning of the interbank market.

1.4 The influence of monetary policy on money market interest rates

As mentioned, the Bank steers money market interest rates both through the announcement of its own interest rates and through its management of money market liquidity. These monetary policy instruments only exert a direct influence on very-short-term interest rates (up to one week). In view of the depth and liquidity of the secondary market for Treasury bills, the Bank's outright purchases and sales in this market, limited in volume, can have only a very marginal direct effect on one to three-month rates, possibly reinforced by an announcement effect. The Bank mainly influences longer money market rates by altering market participants' expectations, through its control over very-short-term rates.

In fact, the Bank is able to steer money market rates in the desired direction; thus one-month and three-month interbank rates – which are the most important for influencing short-term capital movements – follow the trend set by the Bank's rates.

In the equations in Table 3, changes in Belgian short-term interest rate differentials with respect to the Deutsche mark (one-month and three-month Euro-rates) are explained by differences in official interest rate policy (the Belgian central rate minus the repo rate of the Bundesbank) and the DM/BF exchange rate. The estimations were made on the basis of daily data[6] for the period from 10th February 1991 to 20th August 1996.

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[5] The credits granted by tender in 1995 were somewhat below what the Bank would have been willing to give, as financial institutions, which expected mostly declines in interest rates, were not very much interested in the tender credits.

[6] One must bear in mind that high frequency data often violate the usual hypotheses made in time-series econometrics. During a period of tensions, the volatility of the daily interest and exchange rates increases sharply, whereas after the crisis it quickly returns to its pre-crisis level. Since interest and exchange rates have been much more volatile at some

Table 3
Determination of interest rate differentials against the DM
Period: 11th February 1991 to 20th August 1996

Explanatory variables	Lags, in days	Dependent variable: Change in one-month Euro-rate differential	Dependent variable: Change in three-month Euro-rate differential
Long-term effect:			
[(*RBEF-RDEM*)*xx* - (*NBB-BUBA*)]	1	-0.171*	-0.074*
		(0.043)	(0.023)
Short-term effect:			
Δ (*NBB-BUBA*)	0	0.671*	0.530*
		(0.147)	(0.141)
Δ (*RBEF-RDEM*)*xx*	1, 2	-0.087	-0.118
		(0.094)	(0.075)
		0.003	-0.020
		(0.056)	(0.063)
Δ log(*ER*)	1, 2	54.262*	40.225*
		(10.381)	(7.178)
		14.943**	10.850**
		(7.912)	(6.561)
Balance	1, 2	2.513**	0.635
		(1.409)	(1.168)
		1.266	0.696
		(1.815)	(1.498)
Dummy:			
2nd August 1993		-2.776*	-2.299*
		(0.158)	(0.101)
4th August 1993		3.803*	1.534*
		(0.174)	(0.167)
Constant		0.009*	0.006**
		(0.004)	(0.003)
SEE		0.152	0.119
R^2		0.612	0.491
DW		1.804	1.99

*(**) significant at the 95% (90%) level.
Consistent Standard-error between brackets; the covariance matrix has been corrected for heteroskedasticity in the residuals following Newey-West.
Notation: (*RBEF-RDEM*)*xx*: differential between Euro-BF and Euro-DM for the maturity concerned, *NBB*: NBB central rate, *BUBA*: Bundesbank repo rate, *ER*: DM/BF exchange rate, *Balance*: end-of-day deficit or surplus in trillions.

Changes in the one-month (Euro-rate) differential are strongly influenced by differences in official interest rates between Belgium and Germany and by the evolution of the DM/BF exchange rate. In the long run, we impose the constraint that market and official rate differentials cannot move away and we can see from the adjustment coefficient that market rates move to close the gap.

times than at others, their variance changes over time. This problem, called "heteroskedasticity", leaves the O.L.S. estimator unbiased but inconsistent. In order to make inference about the estimated parameters, one needs to obtain a consistent estimator of the covariance matrix. Here, the correction suggested by Newey-West (1987) is used.

The results for the three-month (Euro-rate) differential are similar, but the impact of changes in the official rates is smaller. This confirms the results of Périlleux and Wouters (1994) for Belgium, and Dale (1993) for the United Kingdom, that the influence of official rates tends to diminish with maturity.

It is also noteworthy that, contrary to the study of Périlleux and Wouters (1994), the liquidity policy of the Bank has no significant effect on the interest rate differential: the coefficient of the end-of-day deficit or surplus is not significant at the 5% level, neither for the one-month nor for the three-month differential. The difference in result, compared to Périlleux and Wouters, can probably be explained by the period under investigation. They considered the period 8th February 1991 to 11th October 1993. Since then the liquidity policy of the Bank has been much more neutral.

2. Tactical aspects

In this section we focus on two major questions. Is there an evolution in the way the Bank copes with the short-term trade-offs between exchange rate changes, interest rate changes and interventions in the foreign exchange markets? Which tactical choices are made in implementing the interest rate policy?

2.1 Short-term trade-offs

Especially since June 1990, when the government decided to peg the Belgian franc to the most stable EMS currencies, the exchange rate objective has become more precise. The Bank will, except in special circumstances, opt for a close relationship between the Belgian franc and the Deutsche mark. Moreover, until now, the Bank prefers the franc to be slightly above rather than slightly below the central rate against the mark, as this strengthens the image and credibility of the anchoring of the franc to the mark. For the same reason, the Bank does not like a too strong position of the franc either.

Obviously, the ERM crisis of 1993 was the only example of special circumstances. Applying the new ERM rules in order to discourage speculation, the Bank accepted in a first stage a greater volatility of the exchange rate. At the same time, the Bank showed by its interest rate policy that it remained determined to maintain its strategy. This firmness and the new budgetary package contributed to the restoration of the credibility of the exchange rate policy. The 1993 experience probably still acts as a deterrent for speculation against the franc.

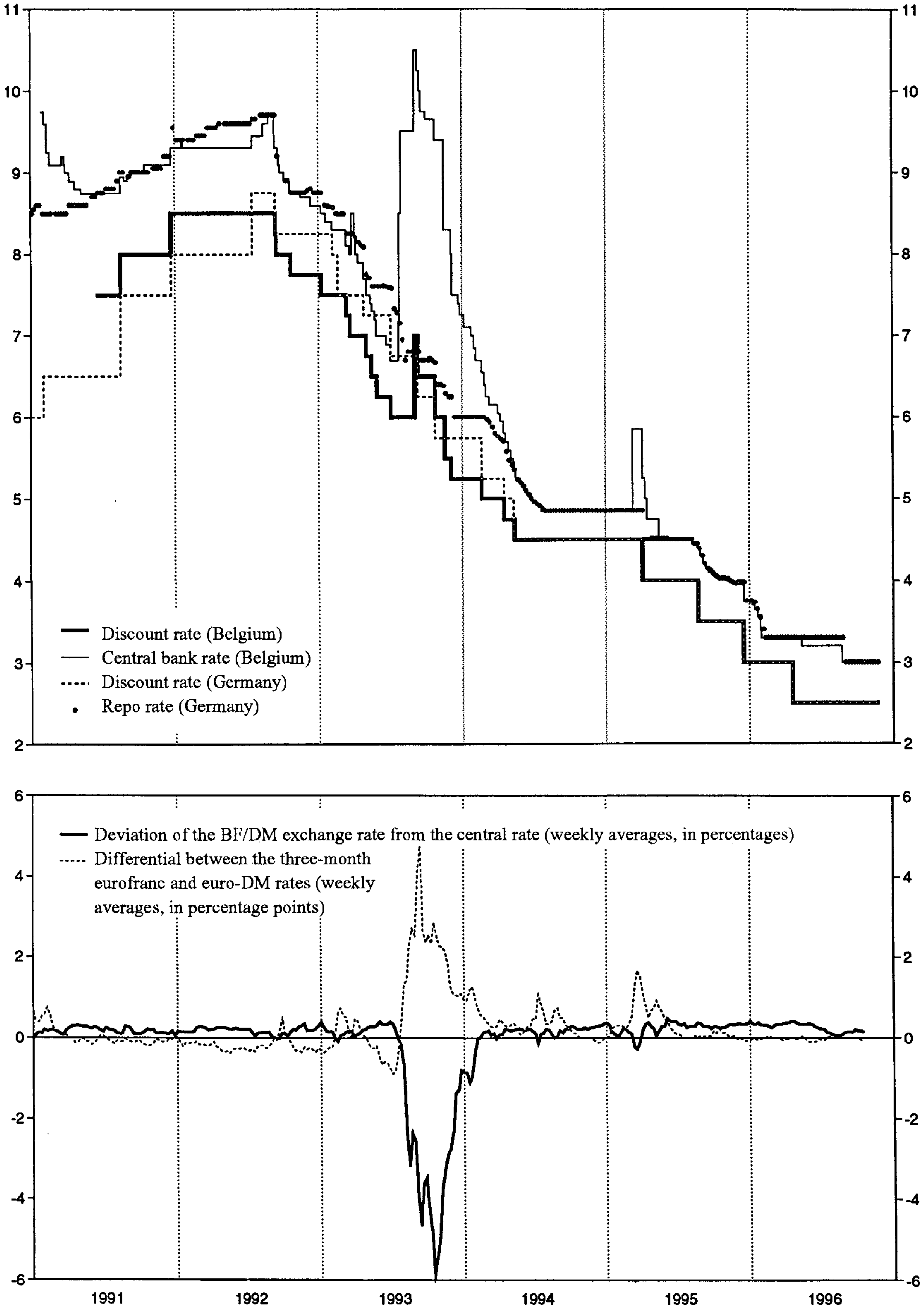
After the ERM crisis of 1993, the Bank shadowed German official interest rates even more closely than before. Since 13th May 1994 the Belgian discount rate has been identical to the German discount rate, while also the Belgian central rate has generally been similar to the German repo rate (see Graph 1). This interest rate policy strengthens the identification of the franc with the mark. On the other hand, the Bank does not hesitate to react promptly to downward pressures on the franc.

As the Bank has pursued its objective of exchange rate stability with a greater degree of precision, interest rate policy has been supplemented by interventions in the foreign exchange markets. Since 1992, the Bank has intervened more frequently in the foreign exchange markets. The speculative crises in the ERM are certainly an important explanation for this. However, since 1994, a reluctance to lower interest rates below the level of German interest rates has led to important purchases of foreign currencies also in quiet periods, in order to counter upward pressures on the franc due to, among other things, the large current account surplus of the BLEU.

Graph 1

Official interest rates in Belgium and Germany and interest rate and exchange rate differentials of the franc in relation to the Deutsche mark

In percentages and percentage points



2.2 Tactical choices made in implementing the interest rate policy

Regarding the interest rate policy of the Bank, one can discern a certain asymmetry between increases and decreases in interest rates (see Table 4). Increases in the central rate are generally larger, and happen less frequently and with greater intervals than decreases. The same tendencies are also apparent for changes in the discount rate.

Table 4
Asymmetries in interest rate policy

	Central rate[1]			**Discount rate[4]**		
	Average duration between changes[2]	**Average size of change[3]**	**Number of occurences**	**Average duration between changes[2]**	**Average size of change[3]**	**Number of occurences**
- -	9	14	83	45	33	19
+ -	10	24	7	94	37	2
+ +	17	45	9	88	50	1
- +	55	35	7	42	100	1

Notation: - - decrease after decrease; + - decrease after rise; + + rise after rise; - + rise after decrease.
[1] From 29th January 1991 to 28th August 1996. [2] In working days. [3] In basis points. [4] From 17th June 1991 to 28th August 1996.

One should be careful in interpreting these results, as the interest rate policy of the Bank is to a large extent determined by moves of the Bundesbank. Moreover, Germany, for most of the period under consideration, experienced a decline in interest rates. Therefore the data do not cover a full interest rate cycle. However, given the primacy of the exchange rate objective, there are good reasons for the Bank to increase interest rates strongly in the case of speculative pressure, and to be careful when lowering rates when the tensions recede.

Following Eichengreen et al. (1994), we define crises or tensions as large movements in interest rates and exchange rates and we construct a composite index with these variables.[7] The components are weighted so that their volatilities are equal:

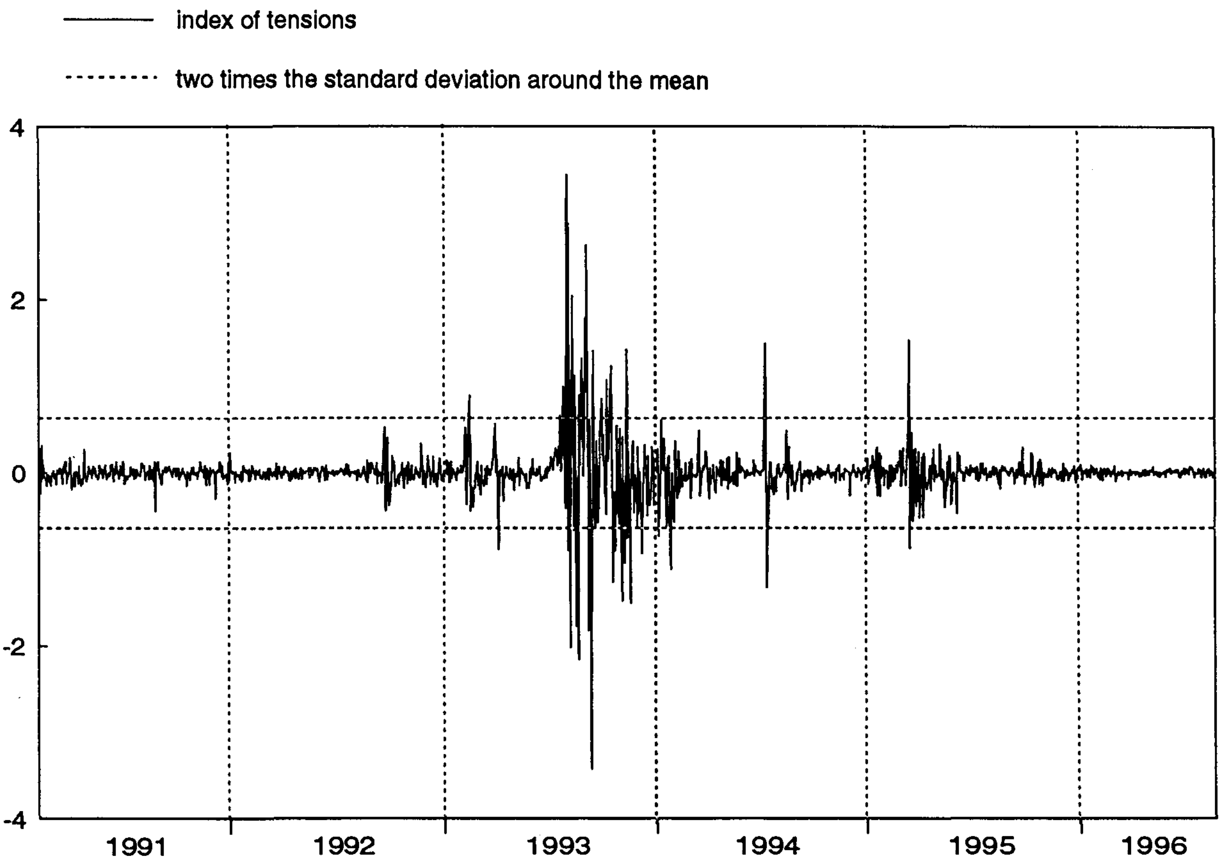
$$index = \%\Delta ER + .988\ \Delta RBEF$$

where $\%\Delta ER$ is the annualised first difference of logarithm of the DM/BF exchange rate, a positive value means a depreciating franc, and *RBEF* is the first difference in the one-month Euro-BF rate expressed on a yearly basis.

The evolution of this *index*, as well as a corridor constituted by two times its standard deviation around its sample mean, are shown in Graph 2. A value of the index above the upper limit means a depreciating franc and increases in short-term interest rates. From this observation, only one period of sustained tensions appears, from 19th July to 7th December 1993. It corresponds to the period of general turmoil in the ERM, with downward pressures on the franc dominating until mid-October and the reversal of these speculative pressures occuring afterwards (see Graph 3).

[7] The use of a composite index has the advantage of defining tensions by something other than only the interest rate differential that we want to analyse.

Graph 2
Index of tensions on the Belgian franc foreign exchange market

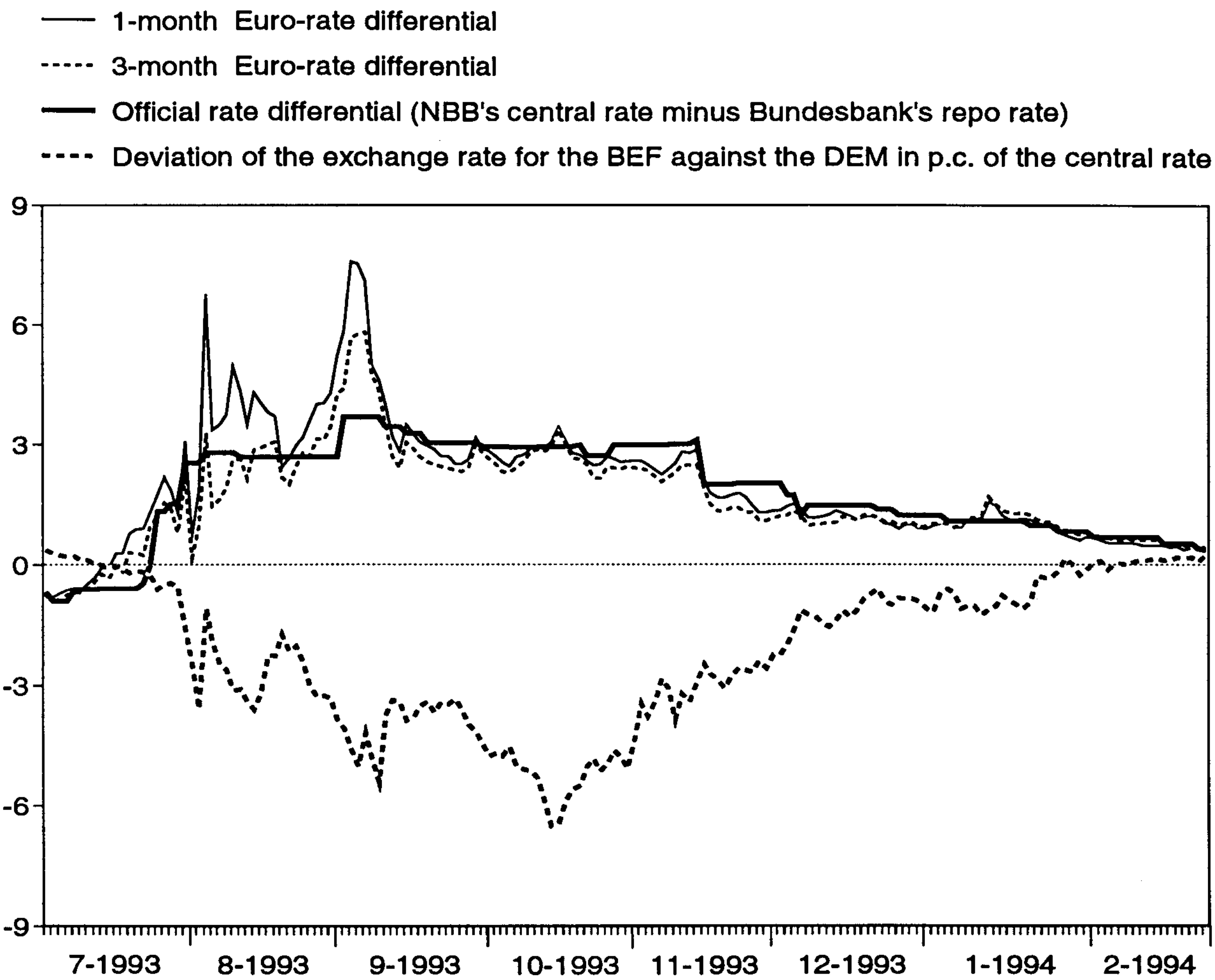


Asymmetry is evident in this period, as sharp increases in the central rate were not followed by decreases of the same size. Despite the commitment to the exchange rate peg, many speculators believed at that time that, as a consequence of the extent of the turmoil in the ERM, the monetary authorities would have to abandon this policy. If these expectations lead market participants to require interest rates of such a high level that they could be considered unsustainable, it would be difficult for the authorities to prove their determination to maintain the peg. Once public declarations are no longer sufficient, the only way for monetary authorities to gain (or rebuild) credibility is to maintain their policy stance after a speculative attack. This strategy, while giving rise to some asymmetry because it does not allow fast and important interest rate cuts in the days or even weeks following the jump, should contribute to lowering market participants' expectations of a change in monetary policy objective after a speculative attack.

Another element which plays a role in interest rate decisions is the stance of budgetary policy. For instance, in March 1993, when the Belgian government offered its resignation, the central bank increased its official rates in order to prevent speculative pressures against the franc. In November 1993, when the adoption of the global plan for employment, competitiveness and social security by the government improved the credibility of Belgian economic policy, the Bank was able to reduce its official rates significantly, without affecting the franc.

Finally, it can be observed that, as the Bank's reaction function is rather clearly revealed, a rise in official interest rates is not always necessary when pressures on the foreign exchange market are slight. For example, in February 1993, July and August 1994, market interest rates rose spontaneously. In February 1993, this rise was also supported by the liquidity policy of the Bank,

Graph 3
BF/DM exchange rate and differentials of market and official interest rates against German rates
ERM crisis of 1993



which aimed at creating end-of-day deficits.[8] Such an action was not even necessary in 1994, as market participants learned from the Bank's attitude in the 1993 crisis. On each occasion pressures quickly disappeared.

In Table 5, we estimate the daily behaviour of the variation in the DM/BF euro-rate differential over the period from 11th February 1991 to 20th August 1996. Since most of the sizeable changes in both explanatory and dependent variables took place during periods of tensions, we also estimate the relationship separately for the period of tensions identified above. These daily changes are explained by adjustments to a long-run equilibrium, and by lagged variations in the exchange rate. Since we are not interested in just the correlation between official and market rates but want to have more insight into the interplay between objectives and instruments, end-of-day balances and interventions in the foreign exchange market are also introduced among the regressors to check the possibility of changing weights placed by the Bank on its instruments-objectives trade-off. To allow the introduction of interventions, we make the identifying restriction that interventions do not respond immediately to a change in market interest rates.

8 There is also an asymmetry in the liquidity management, as the Bank sometimes created large end-of-day deficits but never created large surpluses.

Table 5
Interest rate equation

Explanatory variables	Lags, in days	Overall period: 11th February 1991 - 20th August 1996	Period of higher volatility: 19th July 1993 - 7th December 1993
Long-term effect:			
[*(RBEF-RDEM)1m* - *(NBB-BUBA)*+14.8 log(*ER*)]	1	-0.184 (0.041)	-0.278 (0.070)
Short-term effect:			
Δ+(*NBB-BUBA*)	0	0.665 (0.184)	0.467 (0.218)
Δ-(*NBB-BUBA*)	0	0.445 (0.106)	0.325 (0.157)
Δ log(*ER*)	1	53.370 (12.826)	47.596 (13.094)
Inter	0	-0.0082 (0.0028)	-0.0203 (0.0073)
Balance	1	0.0024* (0.0013)	0.0079 (0.0040)
Dummy:			
2nd August 1993		-3.148 (0.160)	-3.374 (0.252)
4th August 1993		3.879 (0.181)	3.794 (0.274)
Constant		0.017 (0.004)	-0.134 (0.047)
SEE		0.149	0.406
R^2		0.626	0.750
DW		1.892	1.737

The dependent variable is Δ*(RBEF-RDEM)1m*.
Consistent standard-error between brackets; the covariance matrix has been corrected for heteroskedasticity in the residuals following Newey-West.
Notation: *(RBEF-RDEM)1m*: differential between one-month Euro-BF and Euro-DM, *NBB*: NBB central rate, *BUBA*: Bundesbank repo rate, *ER*: DM/BF exchange rate, *Inter*: interventions in foreign exchange markets, *Balance*: end-of-day deficit or surplus in trillions. Δ+, Δ- are respectively the positive and negative changes in the official rate differential.
* Not significantly different from zero.

We first focus on the long-term effect (first row). It has been estimated over the overall period in a first step, using three lags on each variable and assuming Gaussian errors.[9] The first point to note is that long-term disequilibria play a role for changes in interest rate differential, and this remains valid whatever the estimation period considered. Thus, if the official rate differential is modified without affecting the exchange rate – in fact, since 1990, it has remained around the parity – we already know from Section 1.4 that the adjustment of market rates will not be immediately and fully completed. Therefore a disequilibrium will occur. However, this disequilibrium will not persist since this long-term relation has to hold and adjustments will come from market interest rates.

[9] The Johansen procedure has been used and the restriction that market rate and official rate differentials have the same coefficient with opposite sign was not rejected. This is the most robust procedure to obtain long-term relations in the presence of heteroskedasticity, see Gonzalo (1994).

As to the short-term effects, movements of official rate differentials have been decomposed into two separate variables – increases and decreases. As shown previously, changes in market rate differentials are strongly influenced by official rates. However, the impact of increases in official rate differentials becomes slightly weaker when the sample period is reduced to the period of tensions of 1993. This lower response of market rates to official rate increases may come from the fact that during exchange rate crises, the market incorporates an increase in risk premium before official rate movements. The overall period results show a very weak effect of both interventions and end-of-day balances, while the period of tension is characterised by a strengthening of the coefficients of these variables, which is the outcome of a more active management of these instruments in the face of a speculative attack. One must interpret the sign of the effect of interventions cautiously since it may be caused by reverse causality. If the franc is under pressure, both currency sales and interest rate differentials have to increase. But interventions undoubtedly help to limit the depreciation which, in turn, reduces the interest rate differential the day after. Consequently, one cannot infer anything from this coefficient about the final effect of interventions on market interest rates. This would require the estimation of a complete system with exchange rate and reaction functions.

These differences in coefficients between estimation periods probably result from a strategy that tries and succeeds to assert the credibility of an exchange rate objective. At the time of a speculative attack, it is very likely that the most important channel of influence of increases in official rates acts, in fact, through expectations, by giving market participants a clear signal. For a signal to be clear, it must be sizeable. The upward jump in the central rate and its stabilisation afterwards, by reducing uncertainty about the future exchange rate level, may reduce the required rate of return on Belgian franc-denominated assets and, consequently, it may not be fully translated into market rates.

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Monetary policy operating procedures in industrial countries

Claudio E. V. Borio

Introduction[1]

In recent years monetary policy operating procedures have continued to evolve in the light of changes in the structure and workings of financial markets as well as in the broader economic and political environment. Since the Economists' Meeting last visited the subject in 1985,[2] central banks have strengthened the market orientation of policy implementation, cut reserve requirements, widened the range of available instruments, increased the flexibility of liquidity management, sharpened the focus on interest rates as operating targets, improved the transparency of policy signals and shortened the maturity of interest rates serving as the fulcrum of policy. While these trends have resulted to some extent in a continuation of the process of convergence dating back to at least the 1970s, significant differences still exist across countries.

This background paper reviews current monetary policy implementation procedures within a common framework in order to highlight similarities and remaining differences across countries. It also provides some information about their evolution in recent years and suggests possible explanations for the main forces underlying the observed changes. The analysis draws heavily on the responses to the factual questionnaire sent to participants and on further statistical information requested.

The paper is organised as follows. Section 1 outlines the conceptual framework underpinning the analysis. Section 2 offers a very brief overview of existing arrangements, focusing only on the main defining features of national set-ups. Section 3 examines in more detail the characteristics of the demand for bank reserves, treating separately cases in which this is primarily determined by settlement balance needs and those in which reserve requirements still play a major role. Sections 4 and 5 then analyse the supply of bank reserves, broadly defined. Section 4 deals essentially with liquidity management issues, that is, with how central banks go about meeting the demand for bank reserves through adjustments in the supply. It looks in particular at the forecasting process and at the basic features and functions of discretionary market operations and standing facilities. Section 5, by contrast, examines the communication strategies through which central banks attempt to influence and guide market rates. In this context, signalling mechanisms and tactics are considered in some detail. The conclusions summarise the key points emerging from the analysis.

A number of annexes complement the paper. Some of these simply present additional information which was provided in the responses to the questionnaire but which, for reasons of space or compactness, could not be included in the main text. Annex V discusses how operating procedures are adapted and perform at times of severe exchange rate pressure, when they are tested to the full. Annex VI considers the implications of the general shift towards real-time gross settlement at present under way.

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1 The information contained in this paper relates to the arrangements in place in September 1996. This work could not have been produced without the cooperation of the central banks of the countries covered. I would like to thank Joseph Bisignano, Junichi Iwabuchi, Robert Lindley and Paul Van den Bergh for their comments, Angelika Donaubauer, Philip Hainaut and Gert Schnabel for statistical assistance and Stephan Arthur for preparing the graphs and overseeing the publication. Special thanks go to John Kneeshaw for invaluable discussions on the issues covered.

2 "Changes in money-market instruments and procedures: objectives and implications", CB 385, Bank for International Settlements, Basle, March 1986.

1. Conceptual underpinnings

Currently virtually all the central banks in the countries considered in this paper implement monetary policy through market-oriented instruments which they gear to influencing very short-term interest rates.[3] They do so largely by determining the conditions that equilibrate supply and demand in the market for bank reserves (bank deposits with the central bank). It is in this relatively unglamorous and often obscure corner of the financial markets that the ultimate source of the central banks' power to influence economic activity resides.

The market for bank reserves is a special one indeed. The central bank is a monopolist supplier which can also directly affect demand. It can, and often does, affect it, for instance, by setting reserve requirements or by helping to shape the characteristics of, and by operating, key interbank settlement systems. Moreover, the way in which central banks attain their objectives relies on a varying mixture of stated and unstated rules, conventions and communication strategies which are bewildering to the uninitiated.[4]

Despite the complexity and country-specificity of operating procedures, a stylised framework can throw light on how the main features of policy implementation vary with institutional arrangements.[5] The resulting paradigms provide a useful compass for the more detailed analysis that follows. It is helpful to consider the demand for and supply of bank reserves in turn.

1.1 The demand for bank reserves

The characteristics of the demand for bank reserves depend crucially on whether binding reserve requirements are in place.

1.1.1 Working balances

In the *absence of a binding reserve requirement* the demand for bank reserves is essentially a demand for settlement (working) balances. While banks are legally required to settle on the books of the central bank only in a few cases, such as Canada and Australia, they generally do so for several reasons. Prominent among these are the direct access to the ultimate source of liquidity in the system, the reduction in credit risk resulting from settlement in a risk-free medium and competitive considerations, given that the central bank is a neutral participant, and at times even arbiter, in the market.

Settlement balances clearly have a high cost when, as is generally the case, they bear no interest. In this case, ending the day with a positive working balance means incurring an opportunity cost equivalent to the overnight (day-to-day) rate. The main reason why a bank would willingly aim at holding, on average, such positive balances is precautionary, viz. the risk of having to incur a penalty over the market rate owing to the inability to meet its settlement obligations with its existing balance at the central bank. This penalty may take the form of premia on prevailing overnight rates, rationing in the interbank market as limits to credit lines are hit and, finally, penal and possibly uncertain interest rate costs or quantitative restrictions on borrowing from the central bank itself.

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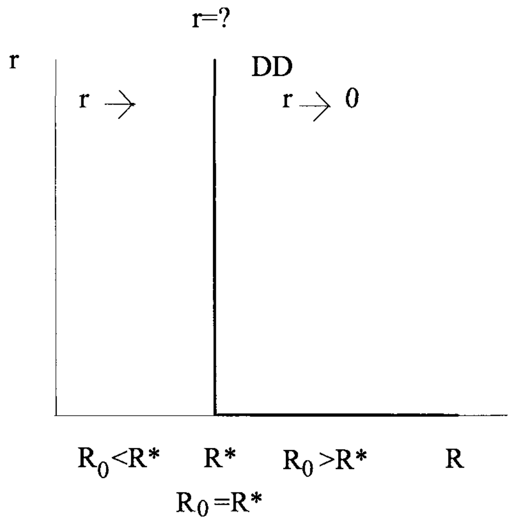
3 A partial exception is the Swiss National Bank, whose main focus is the quantity of bank reserves.

4 In addition, it is not uncommon for interbank markets to be dominated by relatively few players, especially with regard to interbank settlement flows. This can have a considerable influence on the process through which the relevant interest rate, quantities and distribution of reserves are determined in the system. It raises the possibility of strategic interactions between the central bank and market players and between market players themselves. Moreover, it puts a premium on the role of conventions and non-market mechanisms.

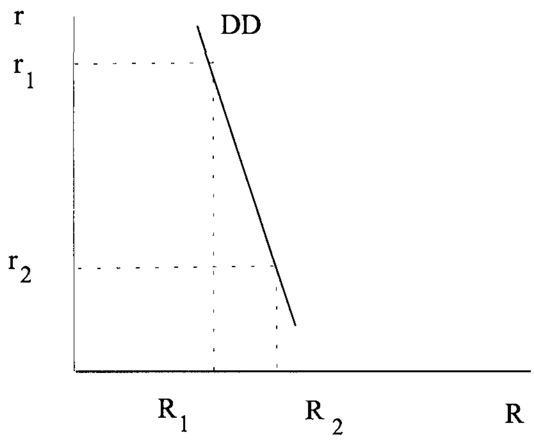
5 This is an adaptation of the framework illustrated in J.T. Kneeshaw and P. Van den Bergh (1989): "Changes in central bank money market operating procedures in the 1980s", *BIS Economic Papers*, No. 23, Basle, January.

Graph 1.1
The demand for working balances

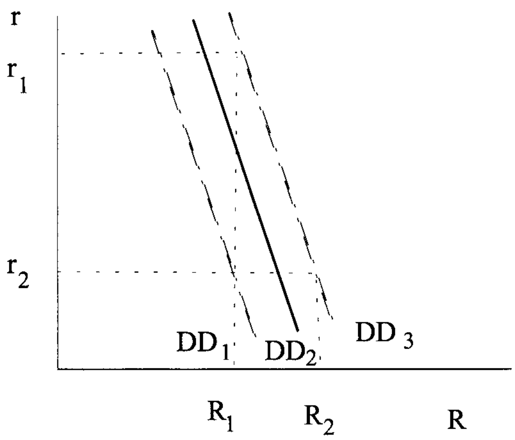
Panel A: No interest rate sensitivity



Panel B: Small interest rate sensitivity



Panel C: Instability



Comments:

Panel A:	The interest rate is either indeterminate ($R_0 = R^*$), tends to zero ($R_0 > R^*$) or to infinity ($R_0 < R^*$).
Panel B:	Small changes in the supply of bank reserves (R_1 to R_2) result in large changes in the interest rate (r_2 to r_1).
Panel C:	Given a low interest rate sensitivity, instability (DD_1 to DD_2) results in large changes in the interest rate (r_2 to r_1) for a given supply of reserves (R_1). Actively providing reserves (R_1 or R_2) can stabilise the interest rate.

Role of signalling: In case A, signalling can help to focus expectations on a particular interest rate within the range of indeterminateness.

As a result, the demand for working balances is largely determined by the institutional and operational characteristics of payments and settlements and by the terms and conditions of central bank late-day assistance. In general, banks would tend to keep their holdings of working balances to a minimum.[6] Indeed, where, as is often the case, the settlement system provides for a period for

[6] If the central bank allows banks to overdraw their central bank accounts on attractive terms relative to the market, they may even target a "negative" balance, that is, they may target to be overdrawn. This is the case in the Netherlands.

borrowing/lending among participants *after* the positions become known, the need for any precautionary holdings is much reduced, if not eliminated: banks would then target (approximately) zero balances.

More importantly, and for much the same reasons, the demand for settlement balances is likely to be *very insensitive* to changes in the overnight rate over its typical range of variation (Graph 1.1, Panels A and B).[7] Reductions in this rate, for example, would hardly in themselves entice banks into willingly increasing their holdings. The demand could also be unstable, especially at the *aggregate* level, if banks failed actively to manage their positions and in the presence of technical or behavioural impediments to a smooth redistribution of reserves in the system (Panel C).

A very interest inelastic, and possibly unstable, demand for working balances calls for an *active management of the supply of liquidity* by the central bank on a daily basis if large fluctuations in the overnight rate are to be avoided (Panel C). It also puts a premium on *signalling mechanisms* aimed at guiding the rate over the regions where it may, in effect, be largely indeterminate.

1.1.2 Working balances

Two preconditions must be fullfilled for reserve requirements to be the binding factor in determining the (marginal) demand for reserves. First, it should be possible to use the reserve requirement holdings to meet settlement needs. Second, the amount of reserves banks need to hold to comply with the reserve requirement should exceed their working balance targets. Clearly, these conditions cannot be met on those days when the reserve requirement calls for a *specific* amount of reserves to be attained. On those days, the factor influencing the marginal demand is the working balance (*excess holdings*) target (Graph 1.2, Panel A). The conditions can be met only if some *averaging provision* exists, allowing individual banks to offset deficiencies with surpluses over a given period. In addition, the size of the deficiencies that a bank would wish to run should not be such as to infringe the minimum working balance needs.[8]

When reserve requirements are the binding factor, averaging provisions can act as a buffer for the overnight rate. At any given point in time in the averaging ("maintenance") period, banks would tend to be indifferent about the amount of reserves they held as long as: (a) the opportunity cost of holding them was expected to change little over the remainder of the period; (b) they held those expectations with little uncertainty or were not much concerned about it (low "risk aversion"). Thus, with fixed or zero-remunerated reserve requirements, they would be indifferent if they were confident that no significant increases/decreases in the overnight rate would take place.[9] Under these conditions, the demand for reserves would be *very elastic* around the level of the rate expected to prevail in the future (Panel B).[10] The high sensitivity of demand to the interest rate would help to cushion the impact of changes in the supply of reserves on the overnight rate (same graph).

The extent to which reserve requirements can act as a buffer declines during the maintenance period. As time passes, the room for manoeuvre is increasingly constrained by the cumulated reserve position, since the number of days available for offsetting any excess/deficiency falls and the size of the corresponding adjustment rises. Similarly, banks would be less willing to arbitrage, as the risks of being unable to offset positions at prevailing market rates would rise. This

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7 This statement should be read as reflecting typical situations; the specific characteristics will depend on the factors mentioned in the previous paragraph.

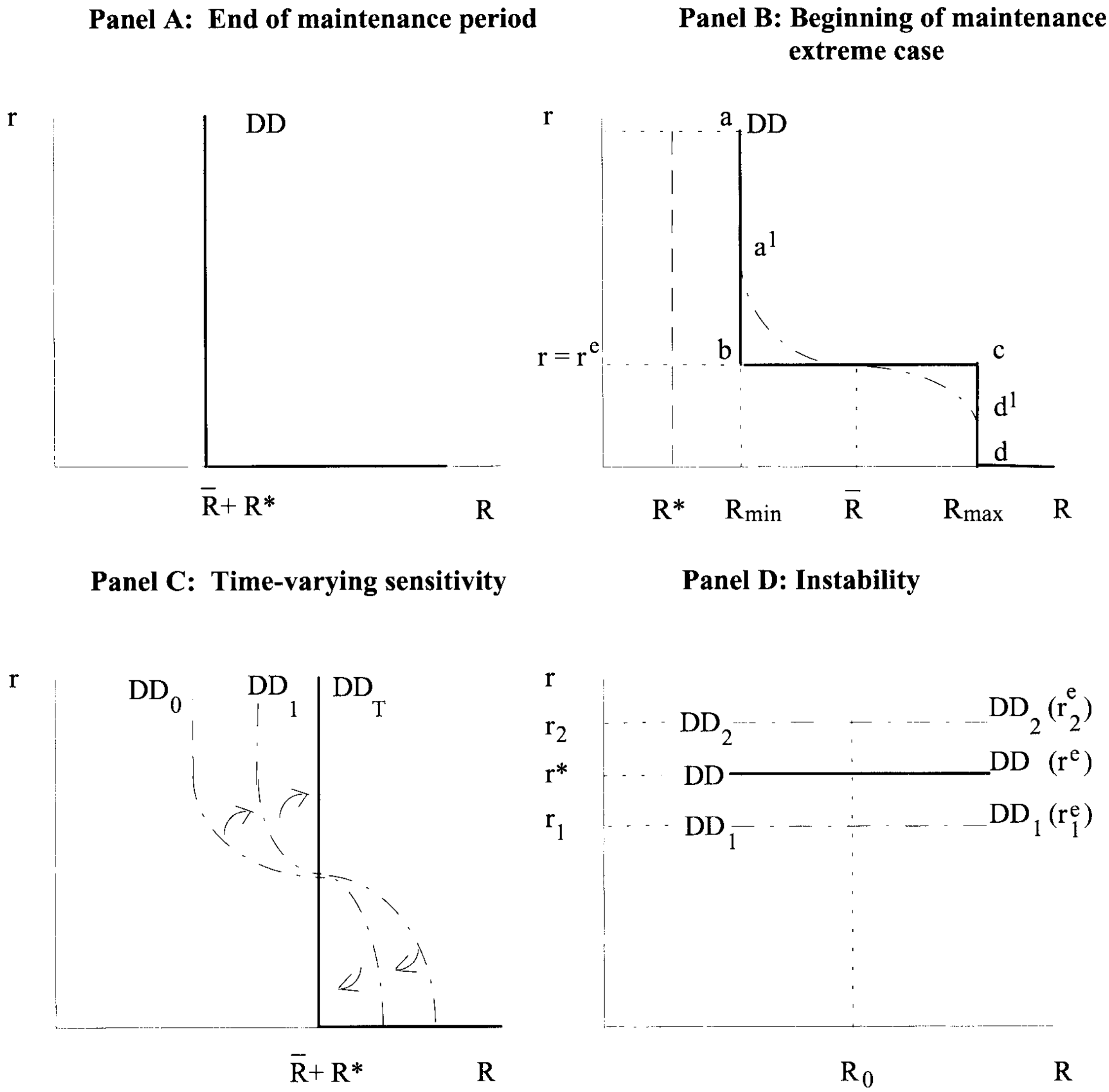
8 More correctly, for given expectations about the evolution of the overnight rate, it should not be such as to make considerations regarding working balance needs influence desired holdings for that day.

9 If the remuneration was fixed as a roughly constant margin below the prevailing overnight rate, banks would tend to be indifferent regardless of the expected path of the overnight rate.

10 Under the extreme assumptions of risk neutrality and uniform expectations, the demand would be infinitely elastic at the expected rate.

Graph 1.2

The demand for bank reserves under reserve requirements



Panel A: At the end of the maintenance period the demand for bank reserves converges to that for working balances (R*) plus whatever amount is necessary to meet the average reserve requirement. (This will be equal to the average requirement itself ($\overline{R}$, as assumed in the graph) in the case in which the banks are already on target in the preceding period.)

Panel B: Within a range determined by the level of requirement and length of the averaging period (R_{min} - R_{max}) as long as the minimum bound exceeds the demand for working balances (R*), the demand for bank reserves will be very elastic (a^1, d^1), and in the extreme perfectly (b, c) elastic, at the level of the overnight rate expected to prevail during the period (r^e).

Panel C: Over time, the demand for reserves converges to that ruling at the end of the maintenance period (DD_0 to DD_T).

Panel D: Changes in the interest rate expected to prevail (r^e_1 to r^e_2) result in similar changes in the market rate (r_1 to r_2) for any given supply of reserves (R_0).

Role of signalling: By focusing expectations around a specific value of the interest rate, signalling can shift the (interest-sensitive) demand for bank reserves to equilibrate the market at a rate consistent with central bank policy (e.g. r* in Panel D).

suggests that the interest elasticity of the demand for reserves would tend to decline, especially towards the end of the maintenance period, converging on the last day to that of working balances (Panel C).[11,12]

These arguments suggest that, ceteris paribus, reserve requirements with averaging provisions call for a *less active* day-to-day management of liquidity by the central bank. The extent to which this is true will depend on their level, on the length of the averaging period and on banks' willingness to arbitrage expected changes in the overnight rate over time. At the same time, averaging introduces a new potential source of instability in the demand for reserves, viz. volatile *expectations* about the path of the overnight rate (Panel D).[13] If anything, this makes signalling even more important as a mechanism for limiting volatility in that rate.

1.2 The supply of bank reserves

Given the characteristics of the demand for bank reserves, the central bank's task is to regulate the supply in order to achieve its interest rate or quantitative objectives. There are essentially two aspects to this task. The first is how to go about adjusting the liquidity position of the system, balancing supply with demand ("*liquidity management*" proper). The second is how to reinforce any influence that liquidity adjustments may have on interest rates through specific communication strategies vis-à-vis market participants (essentially "*signalling mechanisms*").

Liquidity management involves offsetting to the extent necessary the autonomous (net) sources of reserves ("*liquidity*"),[14] which imply changes in the other items of the central bank's balance sheet. While varying somewhat from country to country, these sources include primarily increases in net foreign assets resulting, for example, from foreign exchange intervention; increases in (net) lending to the government; changes in other residual net assets, such as float or capital and reserves (other than those arising from valuation effects; see Box 1); and reductions in currency in circulation ("cash").[15] An *autonomous* surplus (deficit) can be said to exist if autonomous factors lead to a net increase in liquidity withdrawal.[16]

On an ex post basis, the sum of the net liquidity created through the autonomous channels and through central bank operations represents the net addition to bank reserves. On an ex ante basis, it is often useful to think of the difference between the autonomous creation of reserves and the amount demanded as the balance that has to be met by central bank operations (the *net liquidity position*). An integral part of liquidity management is precisely the *forecast* of the net liquidity position, which provides an ex ante basis for the assessment of the need to effect operations (Section

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11 Plus whatever amount is necessary to meet the reserve requirement. In fact, the speed of convergence would depend on the actual liquidity shocks hitting the system. For instance, in the extreme case in which on the first day of the maintenance period the supply of liquidity was so large as to imply reserve holdings of a size equivalent to working balances for the rest of the period to meet the requirement, any flexibility would be immediately lost.

12 Given this convergence, assuming that the demand for working balances is effectively insensitive to interest rates, the rate on the last day would again be largely indeterminate. This implies a considerable potential for instability in the absence of clear signalling. Given intertemporal arbitrage, once the expected interest rate for the end of the period is determined, the equilibrium expected interest rates for the rest of the period can be derived.

13 Strictly speaking, this would also occur in the presence of a demand curve for working balances which was completely insensitive to the current overnight rate. If the central bank cared only about longer rates, the overnight rate would be free to adjust through arbitrage to expectations which would only be anchored at those longer maturities.

14 Henceforth the terms "bank reserves" and "liquidity" will be used interchangeably.

15 Conceptually, one may wish to add to the list also those standing facilities at *below* market rates activated on demand by banks.

16 Sometimes the term "structural" surplus/deficit is alternatively used. However, it would seem preferable to restrict such a term to situations where the surplus/deficit from autonomous factors is highly persistent over time.

4). If the supply falls short of the demand, a "net liquidity deficit (shortage)" is generally said to exist, in which case the central bank needs to inject liquidity; in the event of a "net liquidity surplus", it needs to withdraw liquidity.

Box 1
Stylised sources and uses of bank reserves

Consider an extremely stylised balance sheet of the central bank, with "Δ" denoting the change in the relevant variable.

Balance sheet of the central bank

Assets	**Liabilities**
Δ Net foreign assets	Δ Cash (notes)
Δ Net lending to the government	Δ Bank reserves
Δ Net lending to banks	
Δ Other net assets	

The item "Other net assets" would typically include changes in capital and reserves (negative sign), float and changes in the valuation of assets. Assume that all the channels for influencing liquidity under the control of the monetary authorities over the relevant horizon have been grouped under "Δ Net lending to banks" (or the "***net policy position***"). If so, the other items on the asset side are purely "autonomous". Then, rearranging terms:

Autonomous liquidity position (+, injection/–, withdrawal) =
Δ Net foreign assets + Δ Net lending to the government
+ Δ Other net assets – Δ Cash

and:

Δ Bank reserves = Autonomous liquidity position + Net policy position

From the viewpoint of liquidity management, it is generally useful to think in ex ante terms. Replacing "Δ Bank reserves" by the quantity demanded (implicitly at some desired rate) and rearranging terms we have:

Net liquidity position = Autonomous liquidity position – Δ^d Bank reserves

The net liquidity position is the mirror image of the amount of reserves that the central bank should provide through its operations to balance the market (at the desired interest rate). In turn, bank reserves can be split into two items: reserve requirements (if any) and (net) excess reserves or working balances, depending on circumstances.

Annex I provides a description of changes in national central bank balance sheets along these lines.

Box 2
A taxonomy of central bank operations

The central bank's mechanisms, other than reserve requirements, for adjusting the liquidity (bank reserves) in the market (i.e. making up "net lending to banks" or the "net policy position") can be broken down according to several criteria: by technical form of the instrument, by the degree of discretion exercised by the central bank in its use and by the frequency of its employment.

A possible breakdown ***by instrument***, used in what follows, is:

1. *Central bank lending*: loans and advances, almost exclusively against collateral, not granted through tenders. Defined here to include also the corresponding discounting of securities.
2. *Reversed transactions against domestic currency assets*: purchases (sales) of assets reversed at some point in the future; equivalent in cash-flow terms to collateralised lending (borrowing). From the viewpoint of the central bank, temporary purchases ("repos") inject liquidity, temporary sales ("reverse repos") withdraw it.
3. *Reversed transactions against foreign currency assets*: equivalent to the above but against assets denominated in foreign currency. Foreign exchange swaps are the most common. They can be used either to inject liquidity (temporary purchases of foreign currency) or to withdraw it (temporary sales of foreign currency).
4. *Outright transactions in the secondary market*: firm purchases/sales of outstanding securities.
5. *Issue of short-term paper*: sale of central bank paper in the primary market. Defined also to include issues by the central bank of government paper on its behalf performing a similar function.
6. *Operations in the interbank market*: interventions in the interbank cash market via the collection of deposits and (possibly unsecured) lending.
7. *Transfers of government deposits*: a transfer from the central bank's books to those of banks injects liquidity; a transfer in the opposite direction reduces it.

Operations 2 to 6 are referred to as "market" operations.*

In terms of ***degree of discretion***, a common distinction is between:

1. *Standing facilities*: operations activated on demand by market participants (mainly banks).
2. *Discretionary operations*: carried out at the discretion of the central bank.

In terms of ***frequency***, transactions can be divided into:

1. *Regular*: occurring at a regular frequency, known in advance.
2. *Irregular*: the complementary case.

Typically, the distinction between regular and irregular operations is applied to market transactions only. Irregular operations (other than in the form of central bank lending) are sometimes known as "*fine-tuning*". Contrary to the common usage of the term, however, not all irregular (fine-tuning) operations are designed to modulate precisely the supply of reserves on a day-to-day basis with a view to balancing the market (see Section 4).

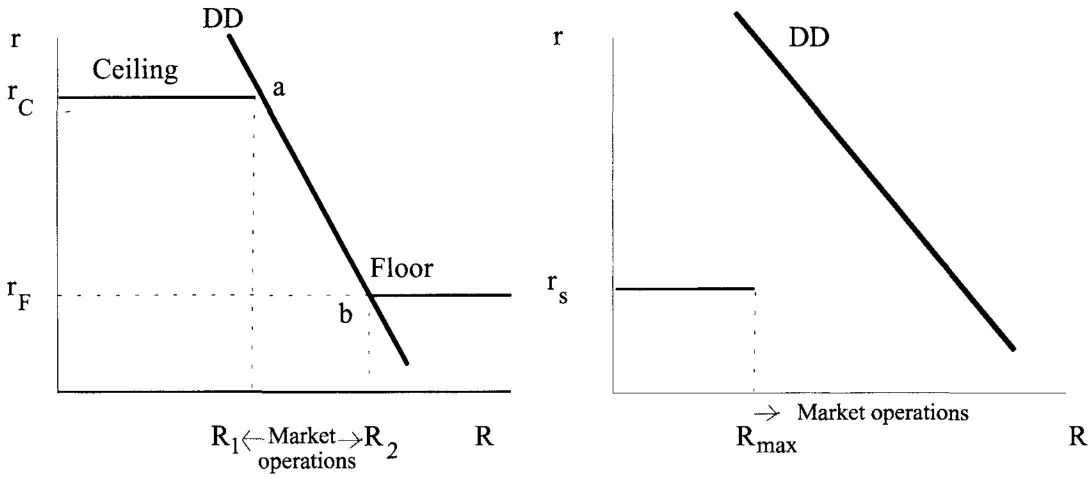
* Sometimes the term "open market" is used even if, strictly speaking, the central bank may restrict the range of counterparties and/or not transact in the established private market.

In principle, central banks can equally meet net liquidity surpluses and shortages. Several central banks, however, prefer to operate with net deficits, as net creditors rather than debtors in the market. Quite apart from their possible influence on the *marginal* demand for reserves, reserve requirements can be aimed at raising the *average* demand, thereby possibly turning an autonomous surplus into a net liquidity deficit. In addition, in a number of systems the operation(s) setting the tone of policy can only inject liquidity ("*asymmetric*" systems). In this case, in order to ensure that the operation remains active, the central bank needs to drain any excess liquidity from the system. When reserve requirements are not in place or insufficient for the purpose, the central bank could then be withdrawing liquidity through some (market) transactions while injecting it through others, possibly even on the same day.

Liquidity can be adjusted either through transactions entered into at the *discretion* of the central bank or through *standing facilities*, which are activated on demand by market participants (Box 2).[17] Either of these may be the effective marginal source of liquidity equilibrating the market. But by and large, and increasingly so, central banks have preferred to use discretionary operations to make the required adjustments in marginal liquidity. Correspondingly, they have tended to use standing facilities primarily as "safety valves" for end-of-day imbalances, as guideposts setting limits to the range of fluctuation of the overnight rate, or, in some cases, as sources of subsidised intramarginal liquidity (Graph 1.3, Panels A and B).

Graph 1.3
The supply of bank reserves

Panel A: Bounds-setting standing facilities **Panel B: Below-market (subsidised) facilities**



Panel A: The standing facility at r_C sets a ceiling to the interest rate; the one at r_F sets a floor. (Given the presence of the facilities, the demand curve will itself tend to be infinitely elastic at the corresponding rates r_C, r_F.) Market operations can be used to affect the supply between R_1 and R_2. The points R_1 and R_2 shift with the demand curve.

Panel B: A below-market facility rations credit to the point R_{max}. As long as the demand for reserves exceeds supply at that rate, r_S does not determine market rates; it merely provides inframarginal, comparatively cheap liquidity.

[17] The distinction between the two need not map one-to-one into the type of instrument used. Reversed transactions such as repos, a typically discretionary instrument, may be offered on a standing basis, or discretion may be used in granting credit through a discount window. Similarly, a standing facility may at times be suspended and the volume of finance or other terms be subject to the discretion of the central bank.

Discretionary operations typically take the form of either firm purchases/sales of securities or, more often, reversed transactions in domestic or foreign currency (Box 2). Especially in countries with reserve requirements and averaging provisions, a distinction is often made between regular and "irregular" transactions. Regular transactions typically aim at providing the bulk of liquidity needs; their timing and, sometimes, maturity are closely tied to the characteristics of the maintenance period.[18] By contrast, irregular transactions are employed to make the necessary adjustments to the volume of liquidity as dictated by evolving circumstances.

Partly owing to the limited use of standing facilities and the characteristics of the demand for bank reserves, central banks rely on signalling mechanisms to guide market views of very short-term rates and hence to strengthen their influence over them (Section 5). These mechanisms may involve adjustments in quantities, but have increasingly taken the form of explicit references to specific interest rate levels. Such signals are sent through announcements of interest rate targets or bands, through the interest rates at which market, typically regular, operations are executed and/or through the posted rate on standing facilities.

1.3 The operating target

Much of the above discussion was conducted in terms of the behaviour of the overnight rate itself: this is the money market interest rate which is largely determined in the market for bank reserves and over which the central bank has the closest control. Yet the overnight rate need not be the main focus or reference for policy (the "*operating objective* or *target*"). The authorities may set their policy in relation to a quantity, such as the path of bank reserves themselves. Alternatively, they may focus on interest rates of a somewhat longer maturity, say one month. In either case, the previous analysis still holds. The main implication is that, ceteris paribus, greater volatility in the overnight rate would be accepted. In particular, if the central bank focused on somewhat longer rates, it would tend to tolerate unexpected movements in the overnight rate provided they did not undermine the attainment of the operating objective.

2. A bird's eye view of arrangements

The foregoing framework can now be used to review the main characteristics of national monetary policy procedures. This section discusses the choice of policy rates and operating targets, the means for stabilising interest rate fluctuations and the main instruments used. A more detailed discussion of the various elements follows in the next three sections. For the sake of comparison, an effort is made to standardise the presentation as far as possible. This may mean that certain features of the procedures may be discussed in ways that are not entirely familiar to the central banks concerned.

2.1 Policy rates and operating targets

As regards the key *policy rate*, that is, the interest rate which best captures the authorities' policy intentions, countries fall into three groups (Table 2.1 and Graph 2.1). In the first, comprising the United States, Japan, Canada and Australia, the most representative policy variable is the *overnight interbank rate* itself. These are countries where tender rates on central bank discretionary operations, as a rule, play no independent signalling role. Signalling strategies differ somewhat in the four cases. In the United States, since February 1994 the central bank has explicitly announced a federal funds target; target announcements have been made in Australia since January 1990. In Canada, since June 1994 the central bank has established an explicit 50 basis points operating band,

[18] Not all regular operations are used for this purpose (Section 4).

Table 2.1
Key features of operating procedures

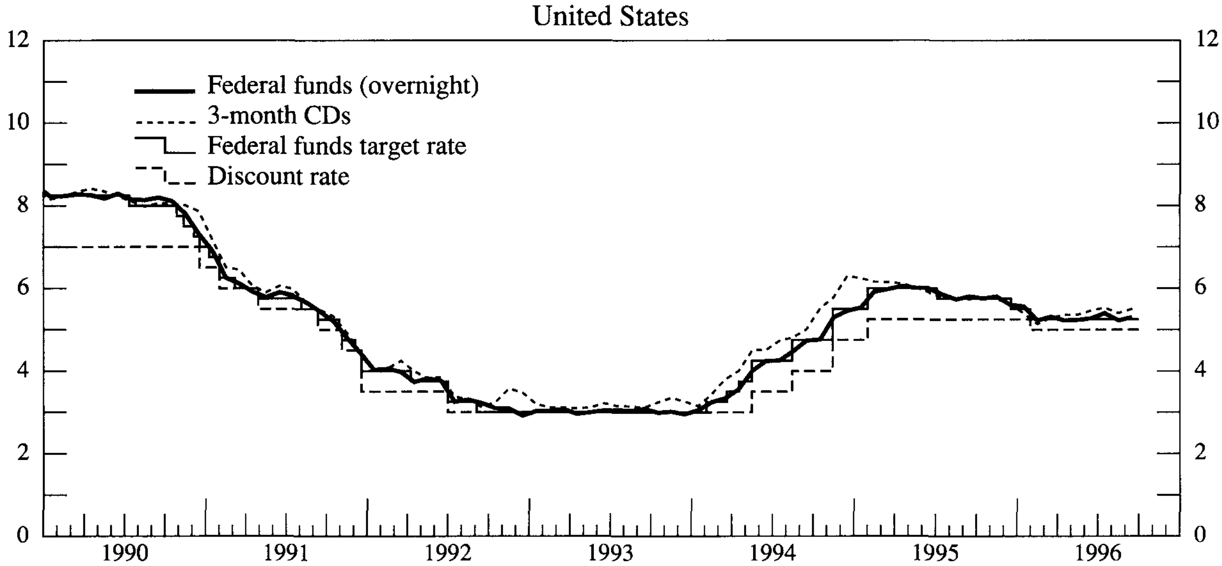
	AU	AT	BE	CA	FR	DE	IT	JP	NL	ES	SE	CH	UK	US
Key policy rate	O/N target	tender	tender	O/N target	tender	tender	tender	O/N	tender	tender	tender	-	tender	O/N target
• maturity (days)	1	14	7-15	1	7	14	<30	1	2-8	10	7	-	1-33	1
Operating target[1]	O/N	O/N	S-T	O/N	O/N	O/N	O/N	O/N	S-T	O/N	O/N	giro deps.	S-T	O/N[2]
• maturity (days)	1	1	30-90	1	1	1	1	1	30	1	1	-	30-90	1
Corridor[3] (bp)		225	225	50	150	200	150			[4]	150[5]		[6]	
Working balances	*		*	*[7]					*[8]		*		*	
Reserve requirements		*			*	*	*	*		*		*		*
• maintenance period		1m			1m	1m	1m	1m		10d		1m		2w
Main operation	RT	RP	RP[9]	TGD	RP	RP	RT	RT	CL[10]	RP	RT	FXS	OT	RT
• maturity (days)	av. 7	14	7-15	1[11]	7	14	≤30	1-90	2-8	10	7	80-120	1-33	1-15
• regular interval	*	*	*	*	*	*	[12]	[13]	*[14]	*	*		*[14]	[15]
• frequency	1 x d	1 x w	1 x w	1 x d	2 x w	1 x w	≥1 x w	≤3 x d	1 x 4d	1 x 10d	1 x w	≈1 x w	≤3 x d	≈1 x d
Overall frequency	1 x d	≈1 x w	>1 x d	>1 x d	>1 x w	≈1 x w	>1 x w	>1 x d	>1 x w	>1 x w	>1 x w	≈1 x d	>1 x d	≈1 x d
Key signals														
• announcement target	*			*[16]										*
• tender[17]		*	*[18]		*	*	*		*	*	*		*	
• standing facility		*	*		*	*	*	*	*		*	*		[19]
• other			*[20]	*[20]		*[20]	*[20]	*[20]				*[20]		

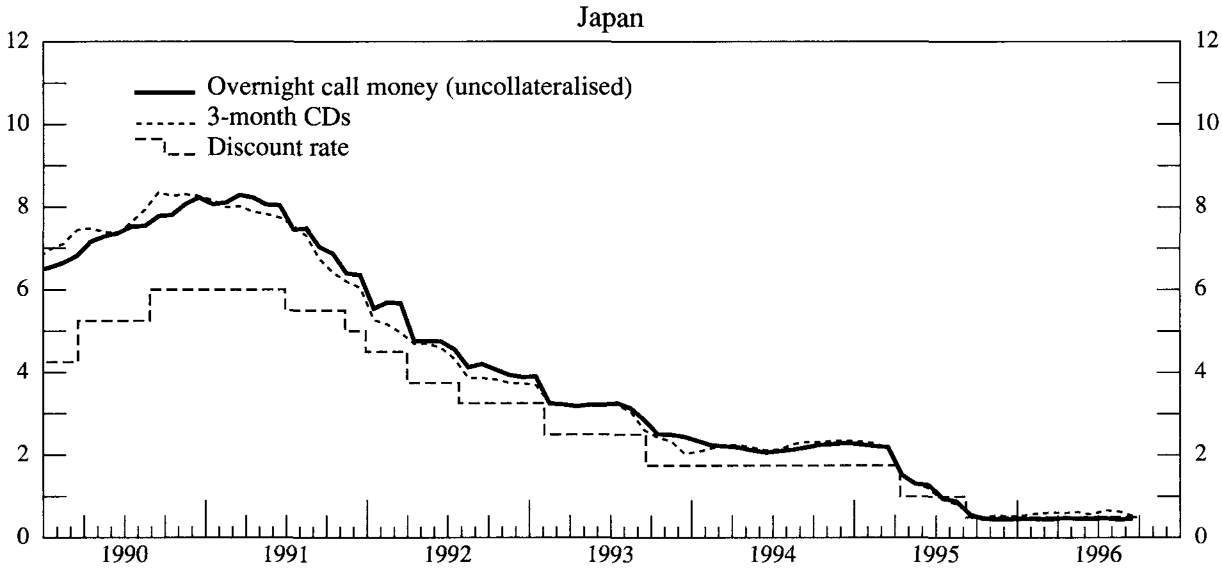
Note: For an explanation of the common symbols used in this and subsequent tables, see the list on page 368.

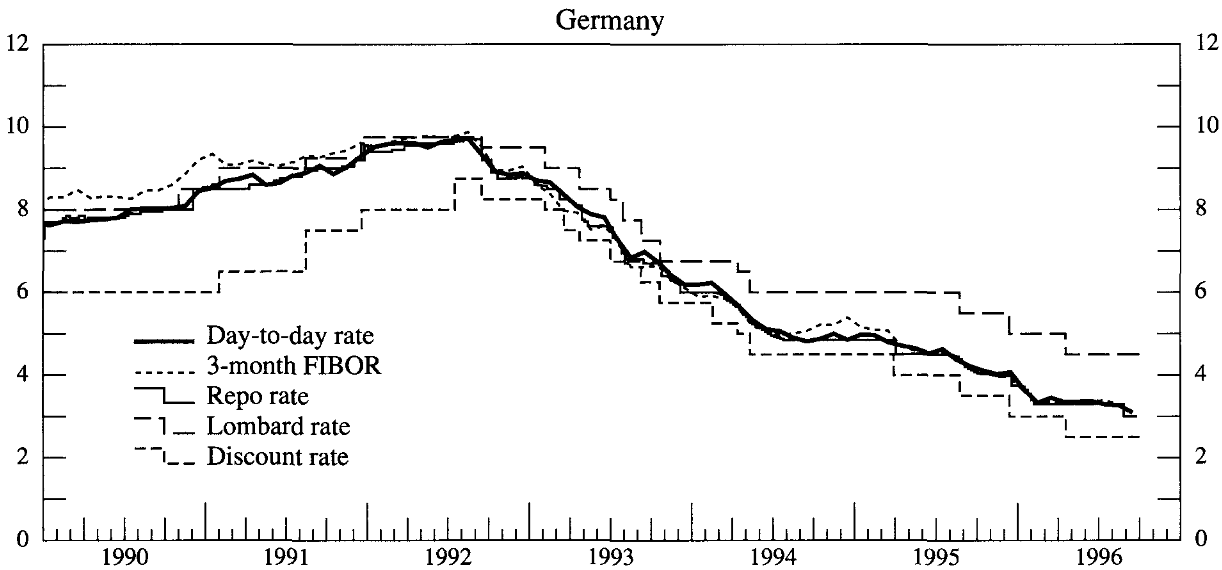
[1] Interest rate unless otherwise stated. [2] Federal funds rate. [3] Either largely self-enforcing or requiring active steering of the overnight rate by the central bank; width measured in basis points, end-September 1996. [4] Overnight rate normally steered within an unpublished corridor of 20-50 basis points, depending on circumstances. [5] Since September 1996 the overnight rate has been steered within a +/-10 basis points range via fine-tuning transactions at the corresponding rates. [6] Deviations of one to three-month rates from the stop rate monitored closely. [7] Averaging around a zero reserve requirement (one month). [8] Demand for overdraft credit granted under the quota scheme to effect payments. [9] Or collateralised loans, depending on assets backing the transaction. [10] Special advances, which are granted through a tender procedure and can be viewed as equivalent to RP transactions. [11] Transfer of demand deposits. [12] On average, every four days. [13] At least two operations per day. [14] Not completely fixed. [15] Almost every day. [16] Bounds of operating band; normally the market takes the midpoint as the target. [17] Refers to the main operation shown above. [18] Tenders are conducted at the central rate, which can be changed at any time. [19] The discount rate had a clear signalling role until the announcement of the target rate. [20] Largely quantity signals (Section 5).

Graph 2.1a

Key official and market interest rates



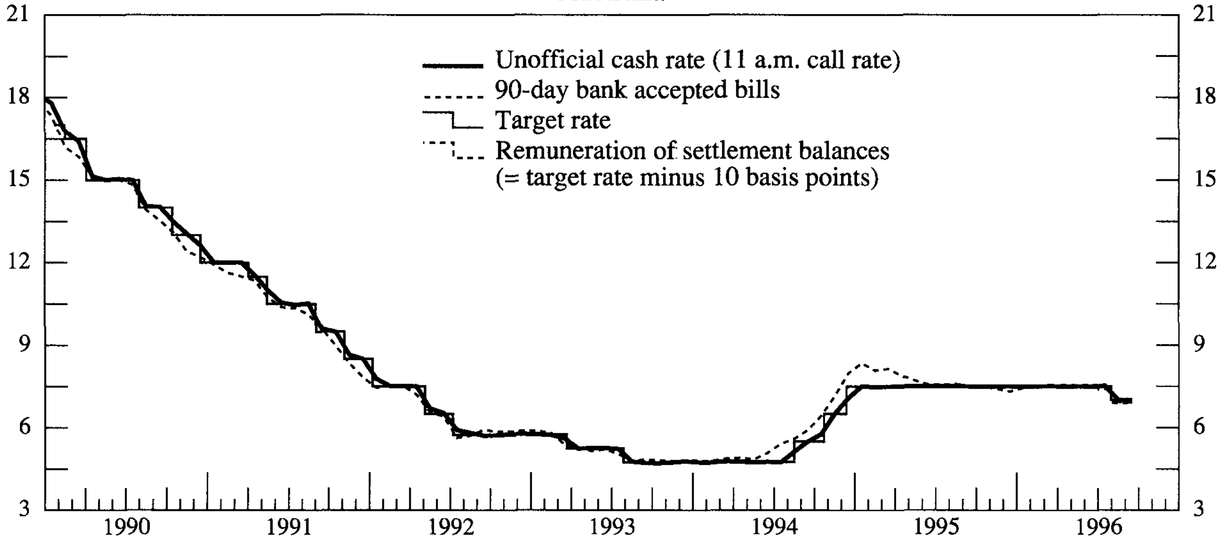




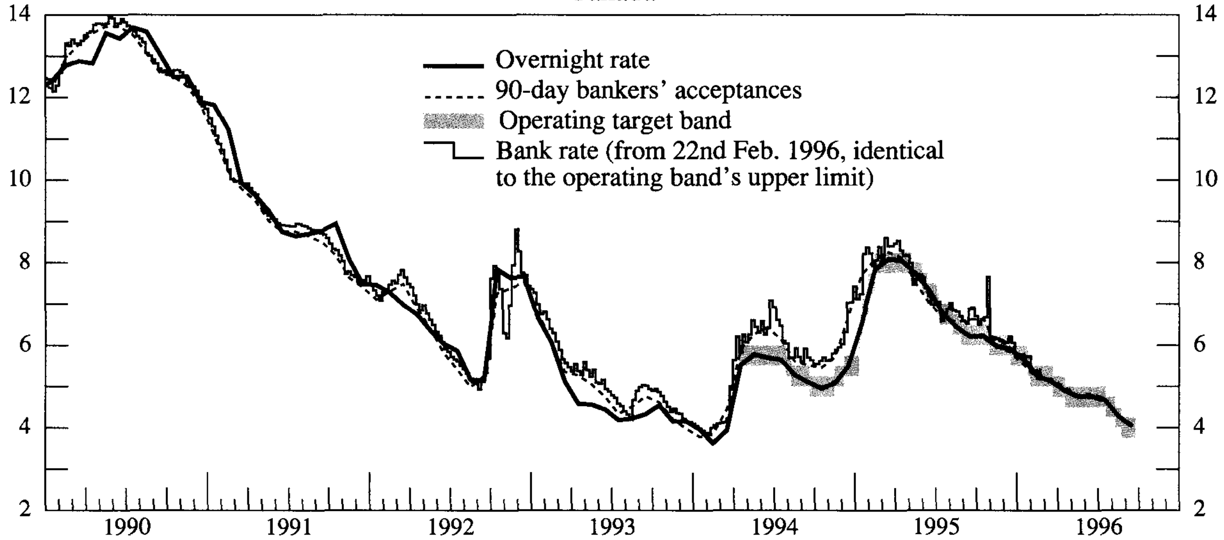
Graph 2.1b

Key official and market interest rates

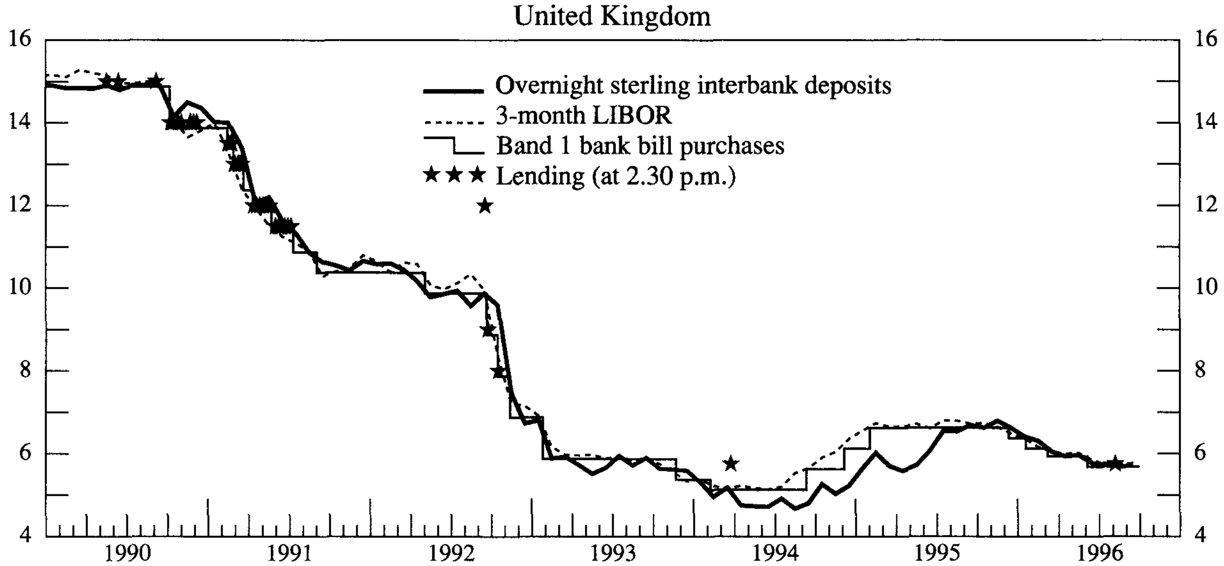
Australia



Canada

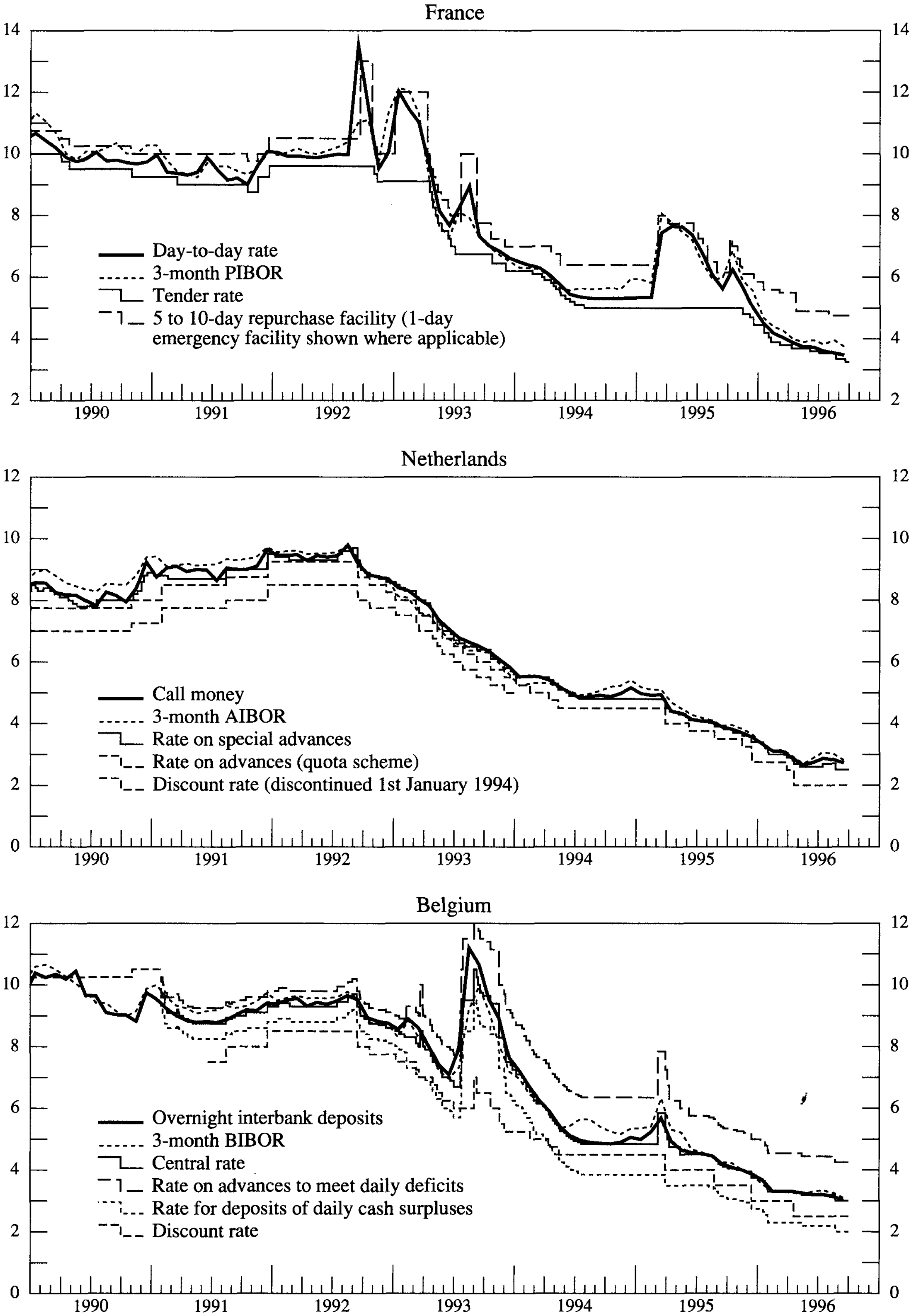


United Kingdom



Graph 2.1c

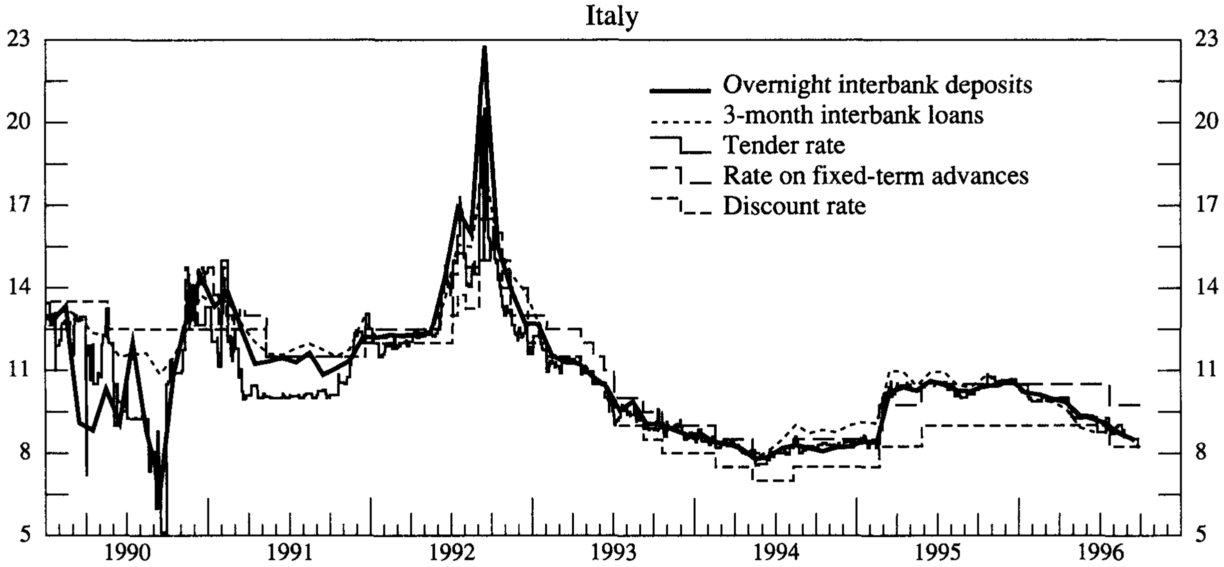
Key official and market interest rates



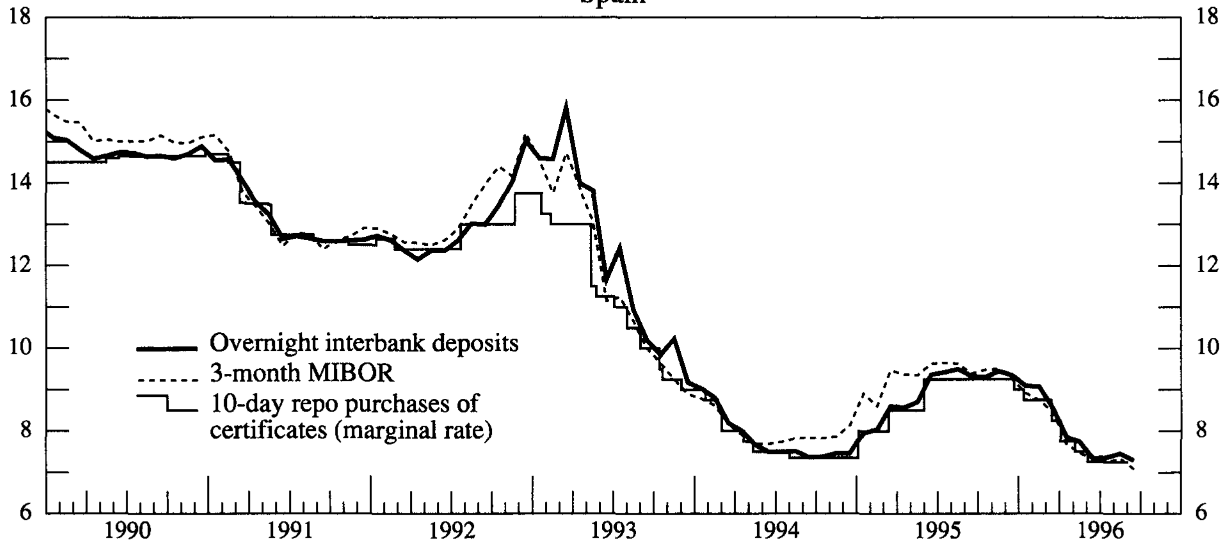
Graph 2.1d

Key official and market interest rates

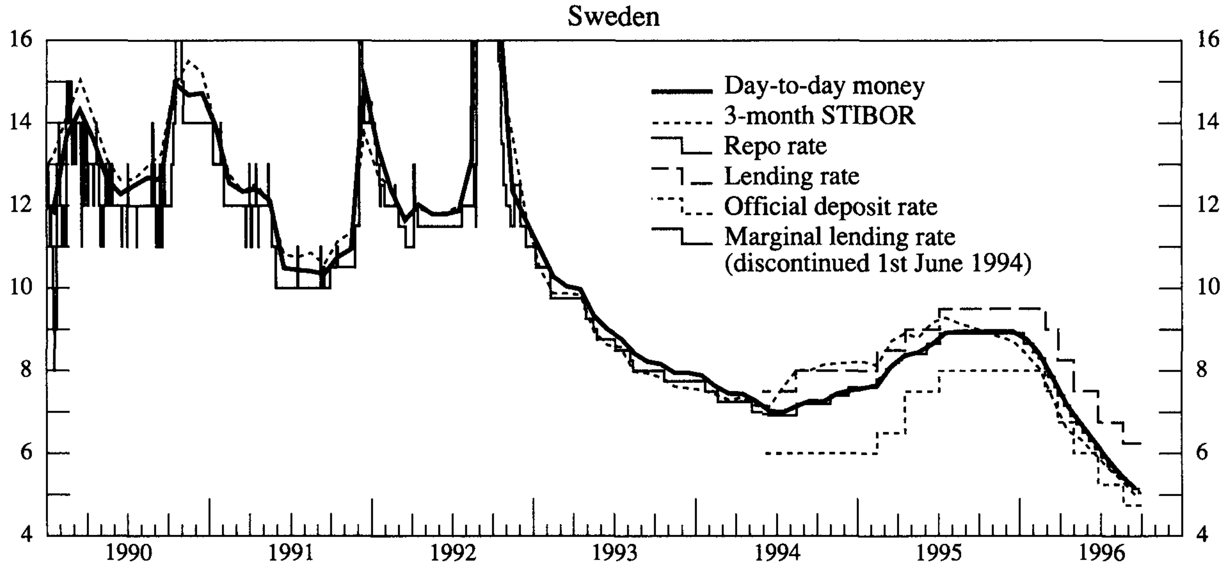
Italy



Spain

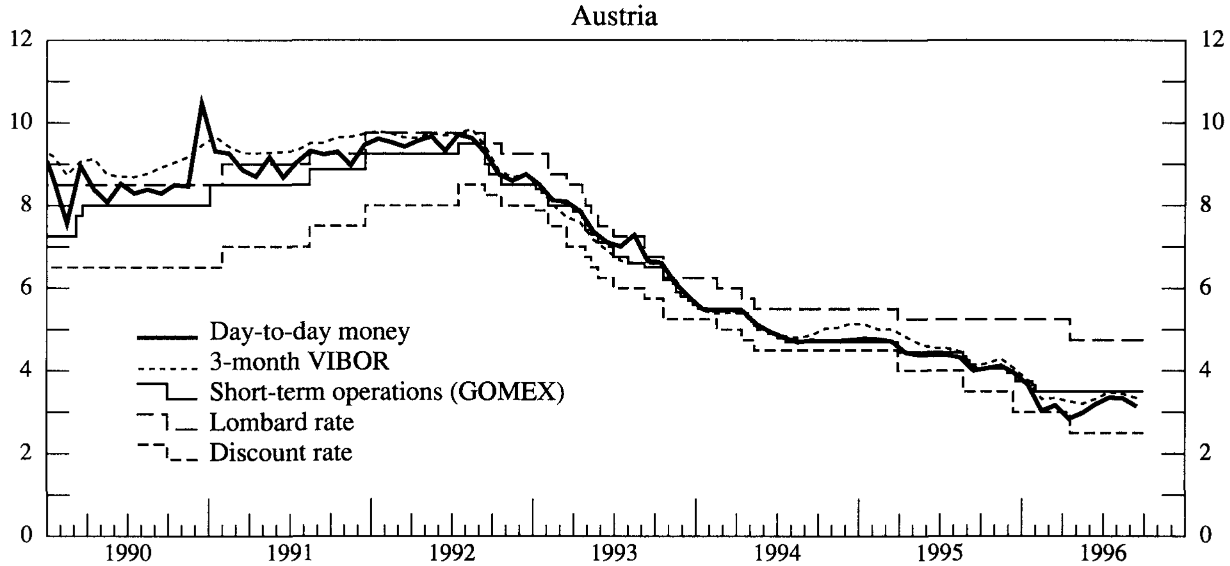


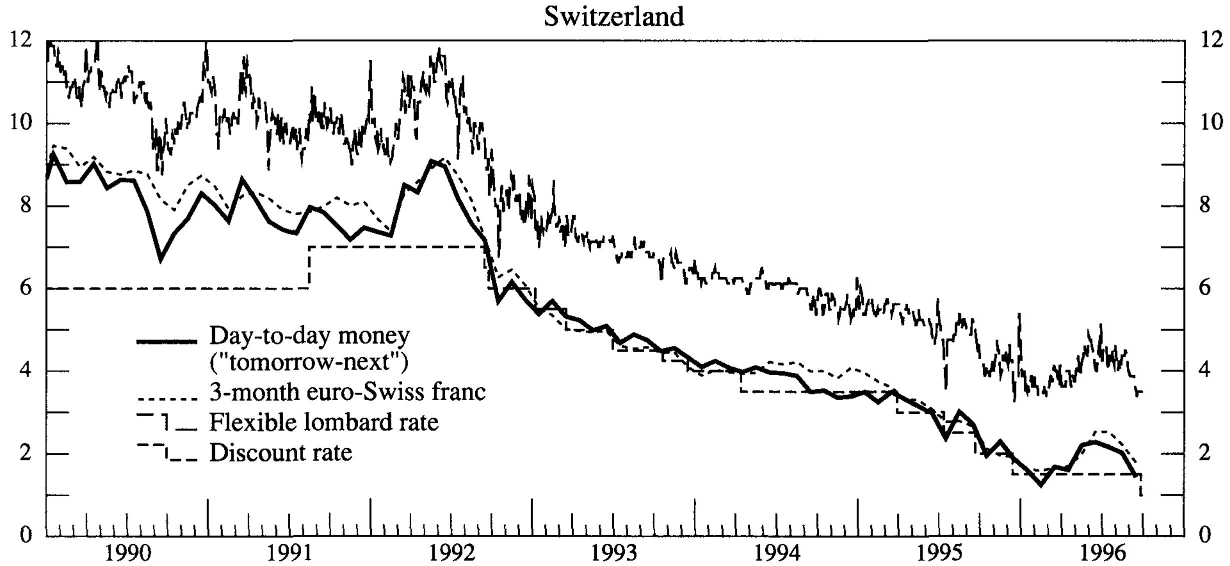
Sweden

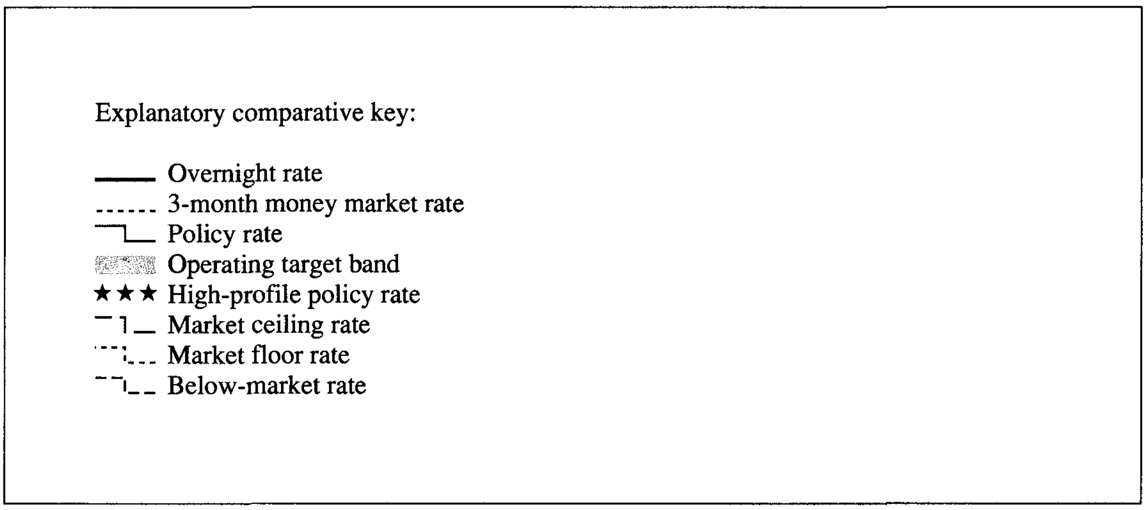


Graph 2.1e

Key official and market interest rates







communicated and validated by the offer to enter into repurchase transactions[19] at those rates. In contrast, in Japan the central bank does not announce a specific target for the overnight call rate. However, since 1995 its policy of communicating policy changes through quantity signals, sometimes reinforced by changes in the discount rate, has been supplemented by statements concerning broadly desired levels for the operating objective (Section 5).

In all the remaining countries, except Switzerland, the key policy variable is the *tender rate* applicable to regular operations, mainly repurchase transactions. The maturity of those operations lies mostly between one and two weeks, but could be as short as one to two days or as long as around one month. In the United Kingdom, the central bank chooses the maturity range at which it will purchase outright eligible (largely commercial) bills, nowadays 1 to 14 ("Band 1") and 15 to 33 ("Band 2") days,[20] while the specific maturity is left to the counterparties. In a few of these countries, and to varying degrees, the rates on standing facilities convey information about the longer-term policy stance. This is especially true for the discount window in Italy, given that the tender rate has less visibility than in the other countries in the group (Section 5).

In Switzerland, as the primary focus is on the volume of giro deposits with the central bank, interest rates are of limited significance in conveying policy intentions.[21] Nevertheless, at times of particular instability in the demand for giro deposits, the central bank has paid closer attention to short-term market rates. Most recently, this has indeed been the case since September 1996 (see below).

These differences in key policy variables across countries can have implications for the extent to which fluctuations in the overnight rate are tolerated. Central banks that define their policy in terms of the overnight rate itself clearly treat it as an operating target. In this case, very high frequency fluctuations may be allowed but only as long as they are perceived as purely technical. Over and above its possible stabilising function, announcing the specific target may be helpful in this respect, since it clarifies the distinction between technical and policy-induced changes. By contrast, in those countries where the key policy rate is a tender rate, and at a longer maturity, the freedom is greater. Here attitudes differ considerably and are not invariant to specific economic and market conditions.

Certain central banks, including those in the United Kingdom, the Netherlands and Belgium, attach comparatively little importance to the overnight rate itself and tend to focus on maturities in the one to three-month range. The others, albeit to different degrees, may be said under normal conditions to follow an overnight rate operating objective. In this case, the overnight rate would typically shadow the policy rate.[22] In Germany, for instance, this has been described as a situation of "money market equilibrium". The authorities would thus use a variety of signalling strategies, alter liquidity conditions in the market and/or rely on the stabilising properties of reserve requirements to bring the overnight rate into line. This strategy, however, may need to be abandoned at times when a greater degree of variability in the overnight rate is called for, most notably when exchange rate commitments come under pressure (see Graph 2.1 and Annex V for a more detailed treatment).

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19 Special Purchase and Resale Agreements (SPRAs) and Sale and Repurchase Agreements (SRAs) at the upper and lower ends, respectively. Since January 1996 changes in the operating band have also been announced through press releases. Until that date the Bank of Canada influenced the overnight rate with a view to achieving a fairly precise target for the three-month Treasury bill rate. For an explanation of the reasons for the change, see Section 5.

20 In the past, the Bank of England also dealt at maturity ranges comprising 33-63 and 64-91 days. Following the departure from the ERM in 1992 and the implementation of the new monetary framework, the Bank of England has started to announce explicitly changes in the official rate at which commercial bill tenders would take place. The central rate plays a similar role in Belgium.

21 The discount rate, however, still retains some role (Section 5).

22 In France the policy rate shadows the overnight rate from below.

Most countries in the sample steer the overnight rate within a *corridor*, almost invariably defined by standing facilities at posted rates (see also Table 2.2).[23] However, in only three cases, Austria, Sweden and Belgium, are the characteristics of the facilities such as to automatically enforce the bounds, viz. generous quantitative limits, no central bank discretion and a one-day maturity of the operations. Elsewhere it is typical for the lower bound to be represented by a subsidised lending facility, which would not necessarily be effective in cases of excess liquidity. In addition, credit at the upper bound may be restricted or granted at maturities longer than overnight (e.g. France).

Table 2.2
Standing facilities[1]

	Market ceiling	**Market floor**	**Below market**		**Market ceiling**	**Market floor**	**Below market**
AU	*	*		JP	2		*2
AT	*	*	*	NL			*
BE	*	*	*	ES			
CA	*3	3		SE	*	*	
FR	*			CH	*		4
DE	*	5	*	UK	6		
IT	*		*	US			*

[1] For more details, see Section 4. [2] Discount window credit actually granted with full discretion; the corresponding interest rate has been above market since July 1995. In January 1996 the Bank of Japan announced that it would no longer use discount credit as part of its regular liquidity management operations. [3] Mainly overdraft loans at Bank rate. In addition, discretionary reversed transactions on occasion operated as quasi-standing facilities. [4] Deactivated; used for signalling only. [5] Discretionary issuance of short-term paper on occasion operated as a standing facility. [6] A number of facilities partly aimed at limiting the rise in the overnight rate.

These arrangements simply reflect the practice of relying heavily on discretionary market operations and various signalling mechanisms to steer the rate within the corridor. As a look at the behaviour of the overnight rate indicates, the bounds hardly ever bite for the market as a whole. This is confirmed by the very low standard deviation of the spread between the overnight and the policy rate: excluding episodes of exchange rate pressure and sharp technical movements at the end of the maintenance periods of reserve requirements, fluctuations so measured have generally not exceeded 15 basis points in recent years (Graph 2.2). The corridors are normally considerably larger, allowing for significant flexibility in the movement of both policy and overnight rates.

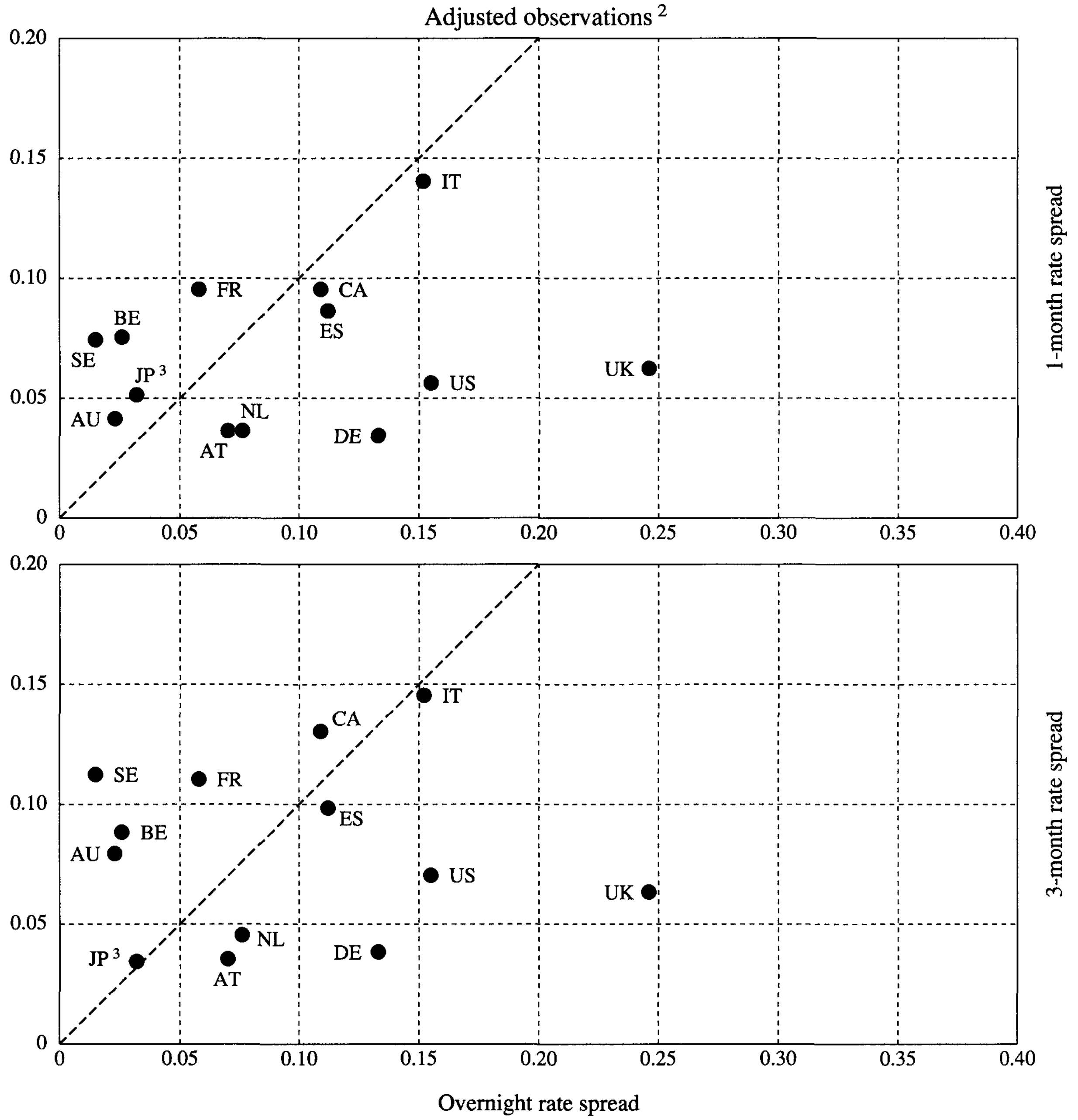
Looking across countries, the choice of operating objective is only imperfectly reflected in the money market term structure of the volatilities of spreads vis-à-vis the policy rate. In two of the three countries focusing on longer-term money market rates, the United Kingdom and the Netherlands, the volatilities of the three and one-month rate spreads are considerably lower than the volatility of the overnight spread; this, however, is not so in Belgium (same graph). Similarly, in a majority of countries focusing on the overnight rate as operating objective, the volatility of the corresponding spread is lower than for longer rates; but the United States and Germany are two notable exceptions.[24]

[23] In France, the lower bound is the tender rate; in Canada, the limits are set by discretionary operations whose impact on end-of-day liquidity is actually sterilised.

[24] The extent to which these results may depend on specific measurement issues is still to be determined.

Graph 2.2a

Volatility of policy rate spreads [1]

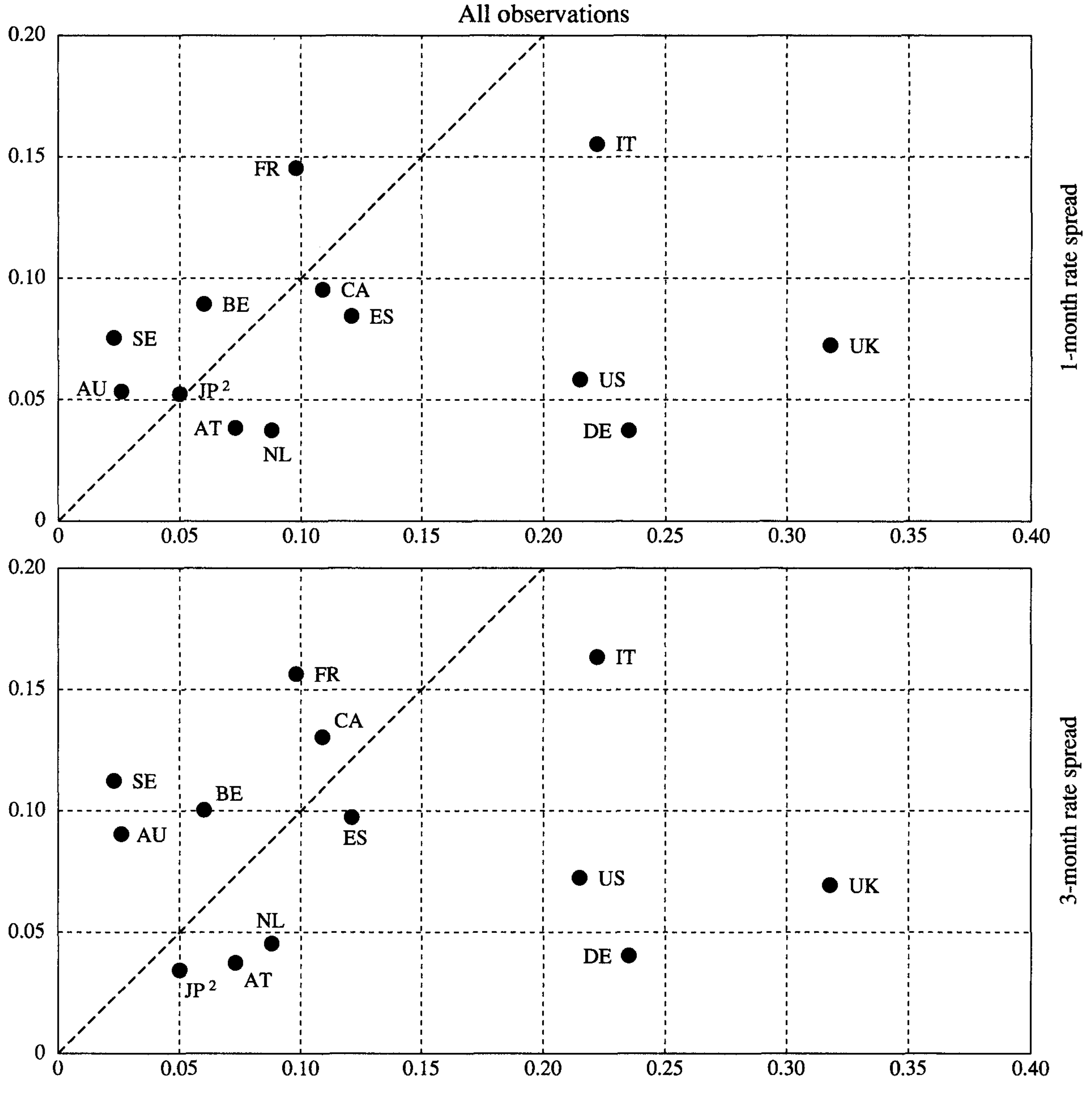


[1] Standard deviation of the daily differential between the chosen money market rate and the policy rate calculated over calendar months, in percentage points; average over January 1994 - September 1996 (for Canada, from 15th April 1994 and for Sweden, from June 1994). [2] Excluding observations at the end of the maintenance periods and at times of exchange rate pressure, where applicable. [3] With respect to an estimated overnight rate objective; approximate only.

Graph 2.2b

Volatility of policy rate spreads [1]

All observations



[1] Standard deviation of the daily differential between the chosen money market rate and the policy rate calculated over calendar months, in percentage points; average over January 1994 - September 1996 (for Canada, from 15th April 1994 and for Sweden, from June 1994). [2] With respect to an estimated overnight rate objective; approximate only.

More generally, in the cross-section of countries there does not at first glance appear to be a positive relationship between volatility spreads at the overnight and longer maturities. A relationship, however, is typically apparent in the time-series within countries (Table 2.3). Taken at face value, these findings would suggest that policies designed to achieve a closer influence on rates at the maturity for the operating objective would normally be associated also with lower volatility at the other benchmark maturities in the money market.

Table 2.3

Relationship between volatilities in policy rate spreads: simple regressions

	1-month on overnight spread			**3-month on overnight spread**			**Period[1]**	**Number of observations**
	coeff.	$\bar{R}^2$	SEE	coeff.	$\bar{R}^2$	SEE		
AU	1.31*** (0.24)	0.27	0.08	1.69*** (0.28)	0.31	0.09	90/1-96/9	78
AT	0.45*** (0.04)	0.65	0.10	0.18*** (0.02)	0.47	0.06	89/6-96/9	87
BE	0.57*** (0.20)	0.11	0.09	0.39** (0.19)	0.05	0.09	91/4-96/9	57
CA	1.01* (0.51)	0.09	0.08	1.07* (0.53)	0.10	0.08	94/4-96/9	30
FR	0.86*** (0.12)	0.35	0.13	0.62*** (0.10)	0.30	0.10	88/10-96/9	86
DE	0.22*** (0.04)	0.19	0.05	0.16*** (0.04)	0.12	0.04	85/8-96/9	130
IT	0.42*** (0.05)	0.54	0.16	0.37*** (0.05)	0.48	0.16	91/1-96/9	64
JP[2]	0.98*** (0.13)	0.46	0.04	0.98*** (0.10)	0.63	0.03	91/2-96/9	62
NL	0.07*** (0.02)	0.15	0.03	0.06*** (0.02)	0.07	0.04	87/1-96/9	113
ES	0.99*** (0.11)	0.65	0.09	0.49*** (0.11)	0.29	0.10	91/12-96/9	48
SE	0.21 (0.57)	-0.04	0.07	0.04 (0.63)	-0.04	0.08	94/6-96/9	26
UK	0.21*** (0.03)	0.36	0.06	0.17*** (0.03)	0.23	0.06	87/1-96/9	100
US	0.24*** (0.06)	0.20	0.04	0.36*** (0.07)	0.24	0.05	89/8-96/9	74

[1] Regression of the volatility of the spread between the one-month (or three-month) rate and the policy rate on the volatility of the corresponding spread for the overnight rate; calendar months; excluding episodes of exchange rate pressure and observations at the end of the maintenance period, where applicable. [2] Based on an estimated overnight rate objective; approximate only.

2.2 Inbuilt stabilisers versus frequency of operations

Standing facilities and signalling aside, the volatility otherwise induced in the overnight rate by the variability of the net supply of liquidity through autonomous factors can be reduced in at least two ways: through the buffer property of reserve requirements and through active liquidity management, by means of discretionary liquidity operations. The relative importance of these two factors varies considerably internationally, although the general downward trend in compulsory ratios in recent years (Section 3) has been shifting the balance towards liquidity activism.

In almost half of the countries covered the demand for working balances is the relevant factor affecting the marginal demand for reserves, viz. the United Kingdom, Canada, Australia, Belgium, the Netherlands and Sweden. In these cases, reserve requirements are either not in place or, if they are, do not allow the use of the corresponding balances for settlements purposes, as in the Netherlands and Australia. In Canada and the Netherlands averaging provisions in overdraft facilities are designed to limit the variability in the overnight rate. In Canada banks are penalised only if their average settlement balance is negative over one-month periods;[25] in the Netherlands a three-month averaging procedure applies to overdrafts granted within bank-specific quotas at slightly below market rates, so that banks aim at holding their accounts with the central bank overdrawn.[26]

In the remaining countries reserve requirements with averaging are in place. The averaging period is generally one month but is considerably shorter in the United States (two weeks) and Spain (ten days); such a short period effectively constrains the banks' ability to absorb fluctuations in liquidity. In all of these systems the reserve requirements are the main binding variable affecting the marginal demand for settlement balances. Nevertheless, in some cases the level is now so low that it can compromise their buffer function. This is the case in France. In the United States the economisation on compulsory reserves through so-called "sweep" accounts risks having a similar effect (Section 3).

These differences in the characteristics of the demand for reserve balances are partly reflected in the frequency of discretionary operations. At one end of the spectrum is the United Kingdom, where even excluding irregular fine-tuning operations the central bank may operate up to three times per day.[27] In Canada, Australia and Belgium the central bank generally intervenes once a day; in the United States and the Netherlands several times per week. At the other end of the spectrum is Germany, where fine-tuning operations in addition to the regular weekly tender are typically rare.[28]

2.3 Instruments for market operations

In principle central banks have a broad array of instruments at their disposal for their market operations (Box 2). However, by far the most popular one used at their discretion is the reversed (repurchase) transaction, which in cash-flow terms is equivalent to a collateralised loan

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[25] This is described as "zero" reserve requirements with averaging. The rate on overdrafts is set so as to have banks aiming at zero average balances (Section 3).

[26] In Australia certain participants can in effect choose the settlement and value date (T or T+1). This in fact amounts to a kind of two-day averaging provision with carry-over (equivalently, to an overnight central bank facility at zero cost). In addition, since mid-1996 remuneration of settlement balances at only 10 basis points below the target rate sets a tight lower bound to fluctuations in the overnight rate.

[27] The Bank of Japan also operates up to three times per day: at 9.20 a.m. (signalling operations); at 10.10 a.m. ("house-keeping" liquidity management operations) and, between three or four times a month, later in the day (4.15 p.m.) if there is a need to withdraw liquidity from the system.

[28] Certain technical changes have recently reduced the need for these operations, most notably the reduction in float and the introduction of new arrangements regarding government balances. In the past, their frequency had increased considerably for a while following reunification.

Table 2.4
Discretionary operations: an overview[1]

	Reversed transactions			Outright transactions	Issue of short-term paper	Interbank market transactions	Transfer of government deposits
	Domestic currency		Foreign currency				
	inject	withdraw					
AU	*	*	*2	*			
AT	⊗	*	*3				
BE	⊗		*	*		*	
CA	*4	*4		5			⊗
FR	⊗	*		*		*	
DE	⊗		*		*6		7
IT	⊗	⊗	*	*			
JP	*	*		*	*		
NL	⊗		*2		*	*8	
ES	⊗	*					
SE	⊗	⊗	9			*	
CH	*	*	*				*
UK	*			⊗	*10		
US	*	*		*			

Key to symbol: "⊗" indicates main liquidity management operation with a signalling function.

[1] Other than central bank lending; see Box 2 for an explanation of the taxonomy. [2] Occasionally. [3] In principle; not used for the last two years. [4] Reversed transactions used to signal changes in the operating band but also to enforce its limits; normally sterilised by the end of day via the transfer of government deposits. [5] None since 1995, in part reflecting the greater focus on the overnight rate at the expense of the three-month Treasury bill rate. [6] Issue of "liquidity paper", recently only with a view to setting a floor to market rates; issued by the Federal Government upon request by the central bank, which is economically liable for it. [7] Discontinued in 1994. [8] On a secured basis only. [9] Possible, but extremely seldom. [10] Treasury bill tenders.

(Table 2.4). Repurchase transactions such as repos[29] are preferred to outright open market operations for several reasons: they do not require a liquid underlying market for securities;[30] they essentially have only an indirect impact on the price of the securities transferred, via the injection/withdrawal of liquidity and any associated signalling effects; and they break the link between the maturity of the paper and that of the transaction. Indeed, owing to the great flexibility they provide, repurchase operations are sometimes used also in the form of standing facilities. The emergence and subsequent rapid growth of private repo markets in recent years, often encouraged by the central banks themselves, have further spurred the use of these instruments. Generally, reversed transactions against assets denominated in domestic currency account for the bulk of such operations. At the same time, foreign exchange swaps have become somewhat more significant in a number of countries, mainly

29 Depending on the legal and technical characteristics of the instrument, a distinction is often made between repos and buy-sellback transactions. The terms will be used interchangeably in what follows.

30 On the other hand, they help to increase the liquidity of the underlying market.

owing to the combination of a sharper focus on exchange rate commitments and greater capital mobility. Foreign exchange swaps have traditionally been the main policy instrument in Switzerland.

The only two countries where reversed transactions are not the primary tool for adjusting the marginal supply of liquidity are Canada and the United Kingdom.[31] The Bank of Canada effects daily liquidity adjustments through the redeposit/drawdown facility, by transferring government deposits between its balance sheet and that of clearing banks. In the United Kingdom outright purchases of eligible bills are still the pivotal instrument; the very large outstanding market in the commercial bills has rendered this possible. Since 1994, however, the central bank has made increasing use of repos, a development which is set to continue following the opening of the private repo market in January 1996.[32]

Outright transactions in the secondary market do play some role in a few other countries. In Italy, France and Belgium, where the underlying debt markets are comparatively large, they are sometimes used for fine-tuning or as a structural source of central bank money (France). In the United States, periodic purchases and, infrequently, sales of government securities are used as "permanent" additions/withdrawals of reserves. In Japan, the central bank regularly purchases government bonds in fulfilment of its legal obligation to supply base money to support economic growth.

In a few cases central banks may transact in the primary market by issuing their own or government paper on its behalf. The Bundesbank has sometimes issued "liquidity paper" with a maturity of between one and three days at a pre-announced rate as a means of setting a floor to interest rates.[33] Since 1994 the Netherlands Bank has issued six-month certificates in order partly to release the reserve requirement from its task of inducing a net shortage of liquidity. A similar function is performed by the weekly Treasury bill tenders in the United Kingdom. When withdrawals of liquidity are necessary, the Bank of Japan also issues its own bills, of a maturity between one and five weeks on a tender basis, as a complement to reversed sales of financing bills.

3. The demand for bank reserves

It is now worth examining the demand for bank reserves in more detail. What follows looks at the relationship between the demand for working balances and payment and settlement system arrangements and at the functions and characteristics of reserve requirements.

3.1 Working balances

In virtually all countries, banks target small settlement balances whose amounts appear to be highly insensitive to movements in the overnight rate. The amounts held are largely dictated by the technical and institutional characteristics of payment and settlement arrangements, including the central bank's attitude to the provision of end-of-day marginal financing. These are generally such as to limit the need for precautionary balances (Table 3.1).

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31 For present purposes, the Netherlands Bank's special advances (collateralised loans) can be viewed as reversed transactions.

32 Quantitatively, repos are now even more important. Moreover, the practice of announcing changes in "official" rates has partly deprived eligible bill tenders of their independent policy-setting role.

33 For some time, it also issued similar paper at longer maturities (Annex V).

Table 3.1

Institutional arrangements and settlement balances

	AU	AT	BE	CA	FR	DE	IT	JP	NL	ES	SE	CH	UK	US
Settlement requirement[1]	*			*	[2]									
Main system	N	G[3]	RTGS[4]	N	N	N/RTGS	N	N	N	G	RTGS	RTGS	RTGS	RTGS
• pre-settlement round[5]	*		*		*	*	*	*		*		*	*	*
• intraday monitoring[6]	*	*	*		[7]		*	*	*	*	*	*	*	*
Marginal accommodation	Rediscount	Lombard	Advance	Overdraft	Overdraft	Lombard	Fixed-term advance	Discount	Quota scheme	Loan	Lending facility	Lombard	Overdraft	Discount/ overdraft
• overdraft[8]				*	*[9]				*				[10]	[10]
• pre-known terms	*	*	*	*	*	*	*	*	*		*	*		*
• discretion		*			*[11]	*[12]	*[13]	*		*			*	*[14]
• suasion		*			*[11]	*[12]	*[13]	*		*			*	*[14]
• maturity	≤90d	O/N[15]	O/N	O/N	O/N	variable[12]	1-32d[16]	variable	indet.[17]	O/N	O/N	≥O/N	O/N	O/N
• interest rate	market + 0.75%[18]	Lombard	central + 1.25%[19]	Bank rate[20]	5 to 10-day +2%[9]	Lombard	Fixed-term advances[21]	Discount[22]	Tender - 0.20-0.30%	penal	Lending facility[23]	Lombard[24]	penal[25]	O/N + 4%[26]
• collateral	*	*	*	*	*[9]	*	*	*	*	*		*	*	*
• use	very rare	very rare	marginal	active	rare	rare	common	very rare	active	rare	limited	rare	occasional	infrequent
Remuneration balances	*[27]						*[28]							

Key to symbols: N = discrete-time net settlement; G = discrete-time gross settlement; RTGS = real-time gross settlement.

[1] Legal or regulatory requirement to settle with the central bank. [2] If subject to reserve requirements and entering into transactions with the central bank. [3] RTGS planned for July 1997. [4] RTGS since 24th September 1996. [5] Interbank borrowing/lending after third-party transfers have stopped, when settlement positions may be (approximately) known. [6] Monitoring of settlement positions by banks. [7] Facility exists but is not much used. [8] Overdrafts on settlement accounts in principle allowed. [9] The mark-up is 10% if the loan is uncollateralised. [10] In principle, banks should maintain non-negative balances. [11] Use should be occasional. [12] For short-term needs only and if acceptable in terms of size and duration. [13] Policy aimed at limiting moral hazard. [14] Granted only if all other alternatives at reasonable cost have been exhausted; excessive use discouraged (but see Section 4). [15] Since February 1996; previously 3d-3m. [16] At the discretion of the central bank. [17] Current account advance. [18] Rate applicable after last cut-off (8.45 a.m.); settlement may reopen at 9 a.m.; if the institution is still unable to obtain funds in the market, credit is fully discretionary and at a highly penal rate. [19] If within the agreed credit line; if beyond it ("hors plafond"), considerably higher, at a rate not tied to the central rate; given the size of the credit lines, this occurs only in exceptional circumstances. [20] Close to the overnight rate; if the non-negative averaging constraint on settlement balances is violated, an additional penalty equivalent to Bank rate on an overnight loan equal to the cumulative deficiency is incurred. [21] Discount rate plus surcharge, presently 1.5%. An additional penalty charge (discount rate plus 8%) is applied to advances granted after 4 p.m. [22] The interest charge is calculated by adding one day to the actual maturity of the loan. [23] An additional surcharge of 1% if the bank borrows in excess of 4% of its capital base. [24] Average overnight rate on two preceding days plus 2%. [25] Usually base rate plus 1% and an additional 0.5% if the bank was overdrawn during the preceding (rolling) three-month period. The rate should never be lower than a 0.25% mark-up on the highest overnight rate or the highest lending rate of the Bank of England on that day. Base rate is charged if the overdraft results from an error of the central bank in forecasting liquidity. [26] If unintended overdraft; discount rate otherwise. [27] Overnight target rate minus 0.10%. [28] Excess reserves remunerated at 0.5%.

At least three factors help to reduce the need for precautionary balances. First, settlement procedures are typically designed to allow banks to borrow and lend among themselves towards the end of the day after settlement positions are known or can be estimated with a comparatively small margin of error because other markets have closed and third parties are no longer allowed to transact ("pre-settlement rounds"). As long as this interbank market among settlement participants works sufficiently smoothly, the institutions can be confident of obtaining funds at the going market rate. Difficulties can still arise, especially if a bank builds up a large net debit position, which could put it at a competitive disadvantage in the clearing or even exhaust its available credit lines. Nevertheless, these problems can be alleviated by active monitoring and management of the cash positions during the day. Second, the expectation of being able to finance imbalances at a non-penal rate is generally reinforced by central bank behaviour. As a rule, central banks try to ensure that sufficient funds are available in the system so that participants do not need to turn to them for assistance.[34] Indeed, in the several cases where end-of-day assistance is granted at posted rates, it is precisely this attitude to liquidity provision which ensures that the cost of such assistance retains a penal character. Finally, this modus operandi, buttressed at times by moral suasion discouraging banks from turning to the central bank, in turn encourages the development of an active and efficient interbank market, which over time reduces the need for central bank intervention at the end of the day.

Two major exceptions to this general picture are the Netherlands and Canada. In the Netherlands, since end-of-day central bank overdrafts are granted at (just) below market rates within quotas, banks would willingly attempt, and be allowed, to overdraw their accounts.[35] In Canada the central bank relies on uncertainty in end-of-day positions by transferring government deposits between its books and those of the clearers after the interbank market has closed, so that clearers with deficient reserves would need to draw on central bank overdrafts.[36] In conjunction with the averaging provision on the settlement balance requirement, this element of uncertainty makes the settlement balance target responsive to changes in the overnight rate induced by adjustments in the supply of reserves via the redeposit/drawdown scheme. Supplying, say, a somewhat larger amount than that targeted by banks is expected to put downward pressure on the overnight rate. It is still an open question, however, how much of the downward pressure occurs through a mechanical liquidity effect or, more fundamentally, through the signal conveyed regarding policy intentions (Section 5 and Annex V).[37]

Several pieces of evidence support the view that the demand for settlement balances is typically extremely insensitive to movements in the overnight rate. These include spikes observed in interest rates at the end of maintenance period, when the demand for working balances becomes binding (see below); the efforts devoted in several of the countries without binding reserve requirements to finding out the level of "target" balances of banks, not least by asking them directly (Section 4); the greater liquidity management activism of the central banks in these countries; and, perhaps most simply, the fact that even on a daily basis similar amounts of settlement balances are

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[34] This is so unless they want to give a signal regarding interest rates (Section 5).

[35] However, the fact that the interest rate remains below market rates indicates that the facility does not represent, on average, the marginal source of reserves equilibrating the market, which is provided by special advances.

[36] The central bank transfers the government deposits on the morning of the following day (T+1) before markets open and information about exact clearing positions becomes known. Settlement then takes place retroactively, with value date T.

[37] The distinction here is between a movement along a well-behaved interest-elastic demand curve and a shift in, or choice of a specific point on, that curve (see Graphs 1.1 and 1.2). Note that the overnight rate at T has already been determined once the central bank acts. At best, this rate can be affected by the *expectation* of the central bank supply of liquidity for day T. Similarly, unless what the central bank does for date T conveys information about what it intends to do for date T+1, the beginning-of-day balances at T+1 do not help to determine expected supply for that date. Conditions in the overnight market for funding during day T+1 might be affected, but not the precautionary end-of-day positions.

compatible with very different overnight rates.[38] If this puts a premium on signalling mechanisms, it also raises questions about how signalling can actually "work" (Section 5).

3.2 Reserve requirements

Reserve requirements can perform at least four functions (Table 3.2). First, they can help to stabilise the overnight rate in the face of changes in liquidity conditions (*"buffer function"*). Second, they represent a source of demand for central bank reserves, thus contributing to offsetting the supply of liquidity generated through autonomous factors (*"liquidity management function"*). Third, they can be used as a means of controlling monetary aggregates (*"monetary control function"*). Finally, they can be regarded as a source of revenue for the central bank (*"income* or *tax function"*). Clearly, the same set of requirements would in practice perform more than one function at the same time, but its characteristics would largely depend on the primary objective of the authorities.

Table 3.2
Functions of reserve requirements[1]

	Interest rate buffer	Liquidity management[2]	Monetary control	Seigniorage income[3]
AU				*
AT	*	*		*
FR	*			*
DE	*			*
IT	*	*		*
JP	*			*
NL		*		
ES	*		4	*
CH	*			*
UK				*
US	*		5	*

[1] No reserve requirements are in place in Belgium and Sweden. In Canada banks must maintain a non-negative balance before overdrafts on their account with the central bank only on average during one-month periods. [2] Defined here as a situation in which the requirement is adjusted to absorb the liquidity created by autonomous factors or to create or enlarge a liquidity shortage. [3] Defined as a situation in which remuneration is considerably below market rates. [4] Quantity-oriented procedures until May 1990. [5] Arguably used for this purpose during the period of non-borrowed reserves targeting (October 1979-October 1982).

Few countries retain reserve requirements mainly or exclusively with the objective of raising revenue. This is the sole aim in the United Kingdom (the Cash Ratio Deposits) and in

[38] The very language used by those in charge of implementing policy reinforces this conclusion. They normally talk of meeting the required "liquidity shortage/surplus" without mentioning interest rates as a factor determining it. Hence the distinction is made between "technical" liquidity operations, designed to "balance the market", and "monetary policy" operations, designed to alter the policy stance.

Box 3
Reserve requirement accounting

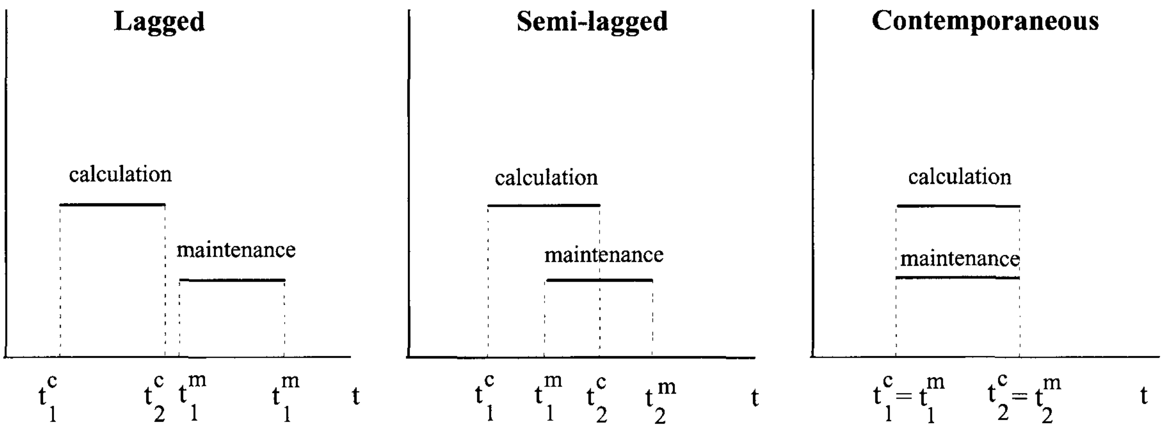
Two important elements defining reserve requirements are the calculation and the maintenance (or "holding") period. The **calculation period** refers to the period (day(s)) taken into account for the calculation of the base to which the compulsory ratio applies. The **maintenance period** is the period for which the corresponding required reserves must be held.

Depending on the degree of overlap between the calculation and maintenance periods, reserve requirements can be classified into three groups, illustrated in the diagrams below.*

Lagged: the calculation period precedes the maintenance period $\left(t_2^c < t_1^m\right)$

Semi-lagged: the calculation period partly overlaps with the maintenance period $\left(t_2^c > t_1^m\right)$

Contemporaneous: the end of the calculation and maintenance periods coincide $\left(t_2^c = t_1^m\right)$



In practice, wholly contemporaneous reserve requirements are not possible because there is typically a lag of at least a couple of days, and sometimes considerably longer, before information on the items making up the base of the requirements (generally deposits) becomes available.

The main significance of the different types is that unless the requirements are lagged, the exact amount of the reserve requirement is unknown at the beginning of the maintenance period and needs to be forecast, both by banks and by the central bank. This adds a further element of uncertainty in liquidity management. With fully contemporaneous reserve requirements, uncertainty prevails until the last day of the holding period. The lag in the collection of the statistics means that between two days and one week may need to be added to the end of the calculation period to identify the day on which residual uncertainty is resolved.

* In the diagram the calculation and maintenance periods are drawn of equal length but this need not be the case. In particular, calculation periods are often defined as averages of liabilities outstanding on a few days and sometimes even as the amounts outstanding on a single day (see Table 3.4).

Australia (Special Deposits). In these cases, the required balances cannot be used for payments[39] and the holding period lags the calculation period (Box 3). In general, however, the marked international trend towards a reduction in reserve requirements over the last decade (Table 3.3) has reflected precisely a wish to reduce the tax aspect of the requirements with a view to lightening the burden on institutions and eliminating competitive distortions, both between types of domestic institution and, increasingly, across national borders. In fact, in the United Kingdom the ratio is kept to the minimum necessary to make up for the fact that seigniorage arising from the note issue is paid automatically to the Treasury; the central bank makes every effort to minimise the burden on the monetary sector. Generally, rough estimates of the implicit tax associated with the requirements indicate that this is typically quite low nowadays, well below ¼% of GDP. Where the level of the requirements is comparatively high, as in Italy, remuneration partly offsets the cost.

Table 3.3
Reserve requirements: size and seigniorage income

	Range of ratios		**Size**[1]		**Seigniorage income**[2]	
	1990[3]	**1996**[4]	**1990**[3]	**1996**[4]	**1990**[3]	**1996**[4]
	in percentage points		**as a percentage of GDP**			
AU	1.0	1.0	0.69	0.79	0.04	0.04
AT	4.5-9.0	3.0-5.0	4.19	2.34	0.04	0.01
BE	-	-	-	-	-	-
CA	...	-	...	-	...	-
FR	0.5-5.5	0.5-1.0	0.90	0.26	0.09	0.01
DE	4.15-12.1[5]	1.5-2.0	2.58	1.08	0.25[5]	0.04
IT	22.5-25.0[6]	15.0[6]	9.58	3.74	0.73	0.12
JP	0.125-2.5	0.05-1.3	1.13	0.68	0.09	0.00
NL	variable	variable	1.28	1.11	0.00	0.00
ES	5.0[7]	2.0	2.80	1.29	0.50	0.10
SE	-	-	-	-	-	-
CH	2.5	2.5	0.71	0.76	0.06	0.02
UK	0.45	0.35	0.31	0.24	0.04	0.01
US	3.0-12.0	3.0-10.0	0.55	0.22	0.04	0.01

[1] Vault cash excluded, if possible. [2] Three-month interest rates applied. [3] End of period. [4] Mid-period. [5] 1991. [6] Applied to the change in eligible liabilities. [7] In March 1990, 17.0-19.0.

In line with the focus on interest rates as operating targets, no country now uses reserve requirements as a means of controlling monetary aggregates from the supply side. This issue has been most relevant in the United States, at the time of non-borrowed reserves targeting (October 1979-October 1982), and Spain, where quantity-oriented operating procedures were in place until 1990. In these two countries, reserve requirements still retain features consistent with such a

[39] Since the recent introduction of RTGS in the United Kingdom the holdings can be used for intraday settlements, but the requirement must still be fully met at the end of the day.

Table 3.4
Main features of reserve requirements[1]

	AU	AT	FR	DE	IT	JP	NL	ES	CH	UK[2]	US	CA[3]	NL[4]
Use for settlements		*	*	*	*[5]	*		*	*		*	*	*
Averaging		*	*	*	*	*		*	*		*	*	*
Carry-over			*[6]								*[7]		
Type	lagged	semi-lagged	semi-lagged	semi-lagged	lagged	semi-lagged	lagged	almost contemp.	lagged	lagged	almost contemp.[8]	-	lagged
Maintenance period	1m	1m	1m	1m	1m	1m	7-10d	10d[9]	1m	6m	2w	4-5w	3m
• end (day)	end-m	end-m	15th	end-m	14th	15th	variable	variable	19th	end-m	Wed.	3rd Wed.	3rd Th.
Calculation period	1m	1m	1d	1m	1m	1m	3m	10d[9]	3m	6m[10]	2w	-	3m[11]
• end (day)	end-m[12]	15th[13]	end-m	15th[14]	end-m[12]	end-m	end-m[15]	variable	end-m	end-m[10]	Monday	-	end-m
Lag[16]	1m	15d	15d	15d	45d	15d	variable	2d	50d	≈6m	2d	-	4m
Vault cash			*						*[17]		*	-	-
• restricted	-			-	-	-	-	-		-		-	-
Remuneration	*[18]				*[19]		*[20]		*[21]			-	-
Penalties		*[22]	*[23]	*[24]	*[25]	*[26]	-	*[27]	*[28]	*[29]	*[30]	*[31]	-
Range of ratios (%)[32]	1.0	3.0-5.0	0.5-1.0	1.5-2.0	15.0[33]	0.05-1.3	variable	2.0	2.5	0.35	3.0-10.0	0.0	variable
Last change	mid-1980s	Sept. 95	Jan. 94	Aug. 95	May 94	Oct. 91	Dec. 96[34]	Nov. 93[31]	Jan. 88	Jan. 92	Dec. 95	July 94	-

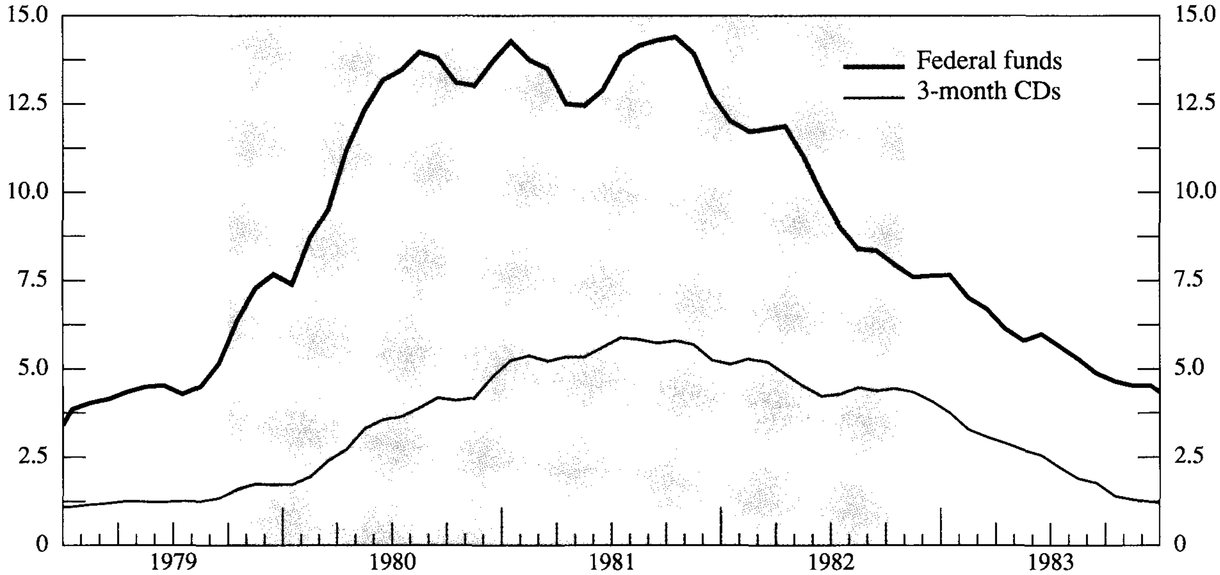
[1] No reserve requirements are in place in Belgium and Sweden; see Annex II for details on eligible liabilities and other features. [2] Cash Ratio Deposit; the Bank of England can also call for Special Deposits (not done since 1979). [3] Description of averaging arrangement for the requirement that settlement balances before overdrafts be non-negative. [4] Description of quota scheme for advances. [5] Each day, no more than 12.5% of the average requirement. [6] Only for excess reserves, 90% up to 2% of the excess, 75% thereafter. [7] For both excess and shortfalls, 4% of the required amount to be utilised in the following maintenance period only. [8] Lagged for vault cash. [9] Actually, 7 to 12 days depending on holidays and weekends. [10] Calculated in April and October on the average liabilities reported at the end of the previous six calendar months. [11] Average of three month-ends preceding the last month-end of the previous period. [12] Based on changes in eligible liabilities. [13] Average of liabilities on 23rd and last day of previous month and 7th and 15th of current month. [14] Average of calendar month ending on 15th of current month or of four days (as in Austria). [15] During the three-month period of the operation of the quota scheme as the maintenance periods are renewed, the base for the calculation remains the same [16] End of calculation period to end of maintenance period. [17] Including also, in particular, postal chequing deposits. [18] Floating, 500 basis points below the 90-day Treasury note rate. [19] Presently, 5.5%. [20] Weighted average of the rate on ordinary and special advances. [21] Postal chequing deposits remunerated at 0.25%. [22] Discount rate plus 3.5% [23] Monthly average overnight rate plus 3%. [24] Lombard rate plus 3% for one month. [25] Presently, discount rate plus 10% for one month (cannot exceed by law the rate on fixed-term advances plus 10%). [26] Discount rate plus 3.75%. [27] Non-interest-bearing deposit for up to three times the shortfall for a period not exceeding the duration of the non-compliance period. [28] Central bank notifies Federal Banking Commission. [29] Ultimately, withdrawal from UK Monetary Sector. [30] Discount rate plus 2%. [31] Bank rate (overnight). [32] Non-zero ones only. [33] Applied to the change in eligible liabilities. [34] The ratio changes every maintenance period.

quantity-oriented approach: comparatively short maintenance periods (two weeks and ten days respectively),[40] almost no lag between the end of the calculation and maintenance periods (almost "contemporaneous" reserve accounting) and, broadly speaking, a definition of eligible liabilities which closely matches that of the previously targeted aggregates (M1 and ALP respectively) (Table 3.4). In Switzerland the traditional operating target, giro deposits, is in fact only one of the assets eligible for the fulfilment of the reserve requirement, actually a liquidity requirement originally imposed for prudential reasons. Recently, an unexpected shift away from reservable postal chequing accounts into giro deposits has tended to result in a temporarily tighter monetary stance than intended.[41] As a result, the central bank has been focusing more closely on interest rates.

The only country where reserve requirements are now intended to perform primarily, in fact exclusively, a liquidity management function is the Netherlands. In order to maximise the flexibility of the requirements in this role, the authorities flexibly adjust the level of the ratio and the length of the maintenance period in order to meet the changing profile of the autonomous creation of liquidity, in particular that arising from changes in the Treasury balance. The amount of liquidity thus absorbed has to ensure that the system is in a net liquidity shortage, consistently with the operation of the quota scheme and special advances, exclusively liquidity-supplying instruments (Section 4). Recently, reserve requirements have been giving way to more market-oriented means of draining liquidity, through issues of central bank certificates. This trend towards a reduced role of requirements as liquidity-draining instruments has been common to several countries, including Italy and Spain.

Graph 3.1

Volatility of the overnight and three-month interest rate in the United States



Notes: Measured as the 12-month moving average of the annualised standard deviation of daily changes during calendar months. The shading corresponds to the period of non-borrowed reserves targeting.

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40 Somewhat ironically, the shift from semi-lagged to contemporaneous reserve accounting in the United States took place in 1984, well after the move to borrowed reserves targeting had greatly reduced the significance of the change by placing a sharper focus on short-term rates.

41 In contrast to giro deposits, postal chequing accounts pay interest but do not serve as settlement balances for the main RTGS system. If the shift reflected an increase in the non-interest benefits associated with giro accounts, it could be interpreted as a sign that the marginal demand for reserves was actually determined by working balance needs. In practice, however, the shift appears to be motivated at least in part by increasing competition between the large banks and the Post Office.

The "buffer function" is by far the most common and economically significant. Even at the time when monetary targeting was more popular, central banks saw no difficulties in principle in reconciling the smoothing of transient fluctuations in short-term interest rates with the control of monetary aggregates over somewhat longer horizons via the demand side, by altering the opportunity cost of holding bank deposits. In particular, this has been the position of the Bundesbank, which has often defended the stabilising properties of reserve requirements. The stricter pursuit of monetary control at the expense of historically high volatility in money market rates during non-borrowed reserves targeting in the United States should perhaps best be seen as a specific reaction to the entrenched inflationary expectations of the time (Graph 3.1).

Consistently with the desire to allow banks sufficient room for manoeuvre, most countries have averaging periods as long as one month. In addition, in order to limit the uncertainty surrounding the level of balances to be held, reserve accounting is lagged or semi-lagged, with the precise requirement becoming known either before the beginning of the maintenance period or, more often, in its second half. The two exceptions are those countries where the requirements had at some point been the focus of a more quantitatively oriented policy, viz. the United States and Spain. This probably reduces their effectiveness in smoothing interest rate fluctuations and calls for more intensive forecasting efforts on part of the central bank (Section 4). Partly compensating for this, the United States allows for some carry-over across maintenance periods. France is the only other country making use of such provisions.

Three examples point to the usefulness of reserve requirements in smoothing interest rate variations (Graph 3.2). Prior to 1989, the maintenance period in Switzerland was effectively the last day of the month only,[42] which led to extreme variability in the day-to-day rate on the last day of the month (the "ultimo" problem).[43] A similar but more muted pattern is still evident in a number of countries at the end of the maintenance period (Graph 3.3).[44] Until reserves were allowed to be used for settlement purposes and averaging was introduced in late 1990, in Italy the overnight rate was very volatile; the central bank focused on the three-month Treasury bill rate. The introduction of averaging was a key element in facilitating the shift to the overnight rate as operating target and, until 1992, in helping with the day-to-day management of tighter exchange rate objectives. Finally, the high variability of the overnight rate between late 1990 and 1991 in the United States has generally been seen as resulting from a cut in reserve requirements which made working balances the main variable determining the marginal demand for reserves. Banks' reluctance to turn to the discount window for late-day assistance exacerbated this volatility (Section 4). The reserve market appeared to calm again as the growth in the deposit base once more raised reserve requirements above clearing needs.

The trend towards lower reserve requirements in recent years has raised the concrete possibility that their buffer function could be impaired in a number of countries. This has been exacerbated where items other than deposits at the central bank count as reservable assets. The most common such asset is vault cash, which is included in required holdings in some of the countries permitting averaging;[45] security risks, transportation costs and competitive equality have generally

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42 The liquidity requirement was monitored and enforced only on that day.

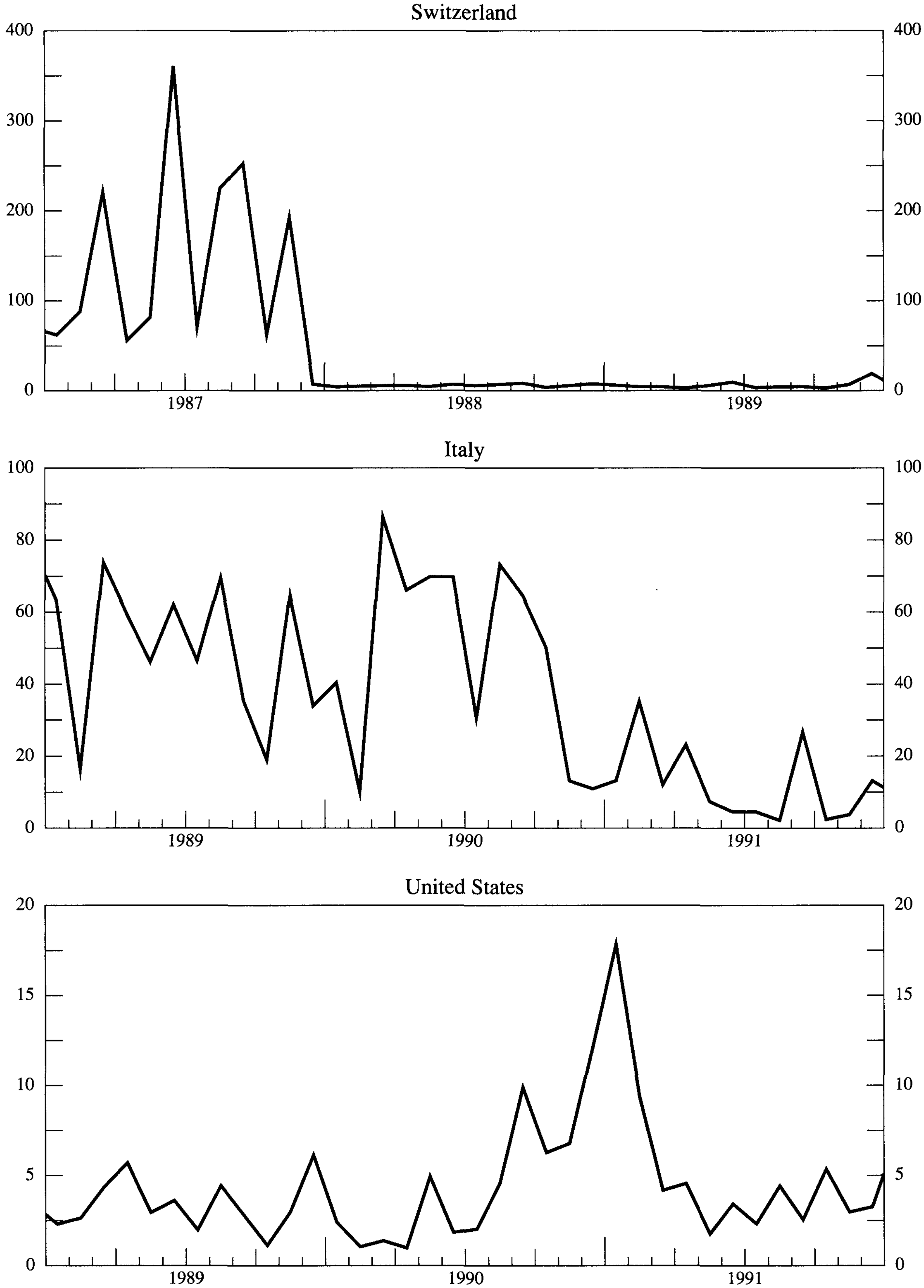
43 In the summer of 1987, Switzerland also moved from a net to an RTGS system (SIC). The combination of the change in reserve requirements with the introduction of the new settlement system resulted in an unexpectedly large reduction in the demand for bank reserves. This greatly complicated the central bank's targeting strategy. The greater stability in the interbank rate, however, essentially reflected the change in reserve requirements alone.

44 Such spikes are generally of little monetary policy significance since they are recognised as being due purely to technical factors. As a result, they are not transmitted along the yield curve. In contrast, in Switzerland, the ultimo problem had been increasingly complicating policy in 1986-87.

45 In Germany, vault cash was included in the requirement until 1995. Its exclusion was partly motivated by the wish not to compromise the buffer function of the requirement.

Graph 3.2

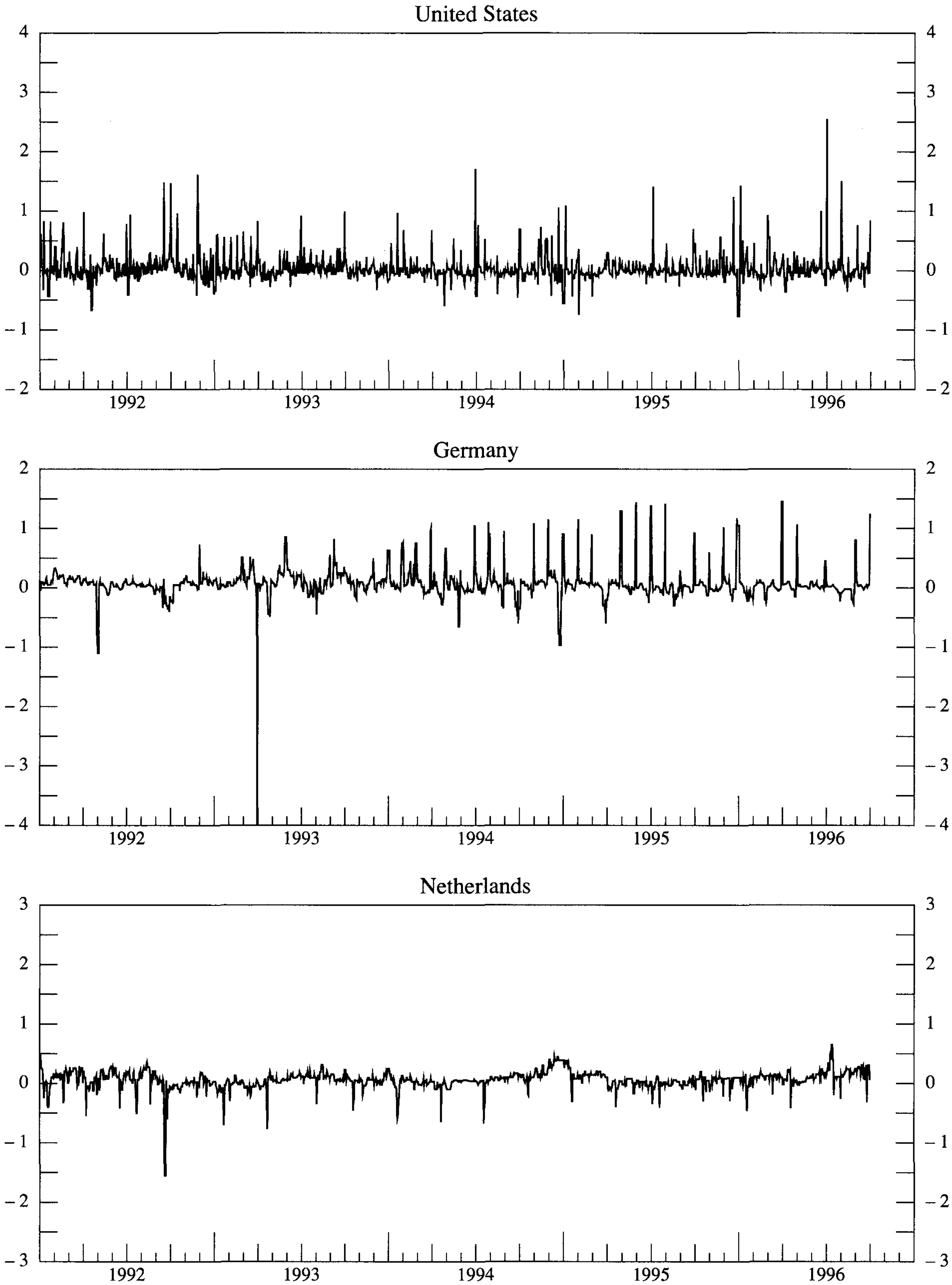
The buffer function of averaging provisions



Note: Measured as the annualised standard deviation of daily changes in the overnight rate during calendar months.

Graph 3.3

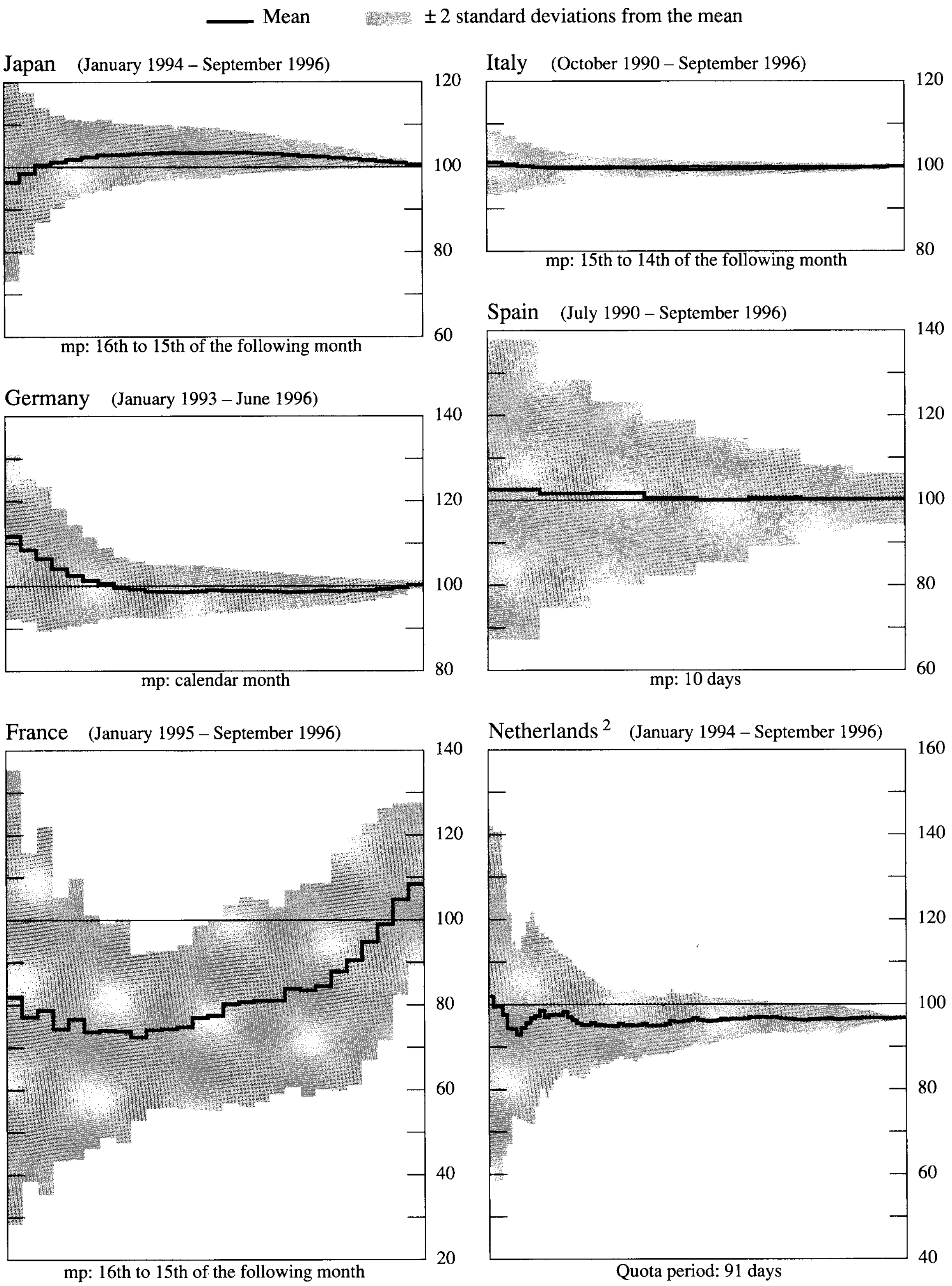
End-of-maintenance-period effects on interest rates



Note: Spikes in the spread between the overnight and policy rate generally correspond to the end of the maintenance period for reserve requirements (or, in the Netherlands, of the averaging period for advances under the quota scheme, which performs a "buffer function" similar to reserve requirements).

Graph 3.4

Patterns of reserve accumulation [1]



[1] Cumulated average of reserves held as a percentage of required reserves during the maintenance period (mp). [2] Cumulated average of utilisation rate of the quota determined under the quota scheme (lending facility), which performs a "buffer function" similar to reserve requirements.

been the main reasons for its eligibility. In France, for instance, vault cash has dramatically reduced the cushion of central bank deposits held for reserve requirement purposes over minimum working balances.[46] The central bank responded in 1992 by introducing special collateralised current accounts to help banks economise on working balances and by stepping up the monitoring of liquidity needs towards the end of the day, contacting the leading banks directly and then, if necessary, balancing the system through bilateral operations. Similarly, in the United States, even several large banks are now in a position to fulfil their requirements exclusively with vault cash ("non-bound" institutions).[47]

In the United States, stepped-up attempts by banks to economise on reserve holdings in recent years through active liability management have given rise to central bank concerns that volatility in the overnight rate may increase once again to levels comparable to those experienced in the late 1990-91 period (Graph 3.2). The main reason has been the spectacular growth since around 1994 in "sweep" arrangements, whereby banks shift retail deposits at the end of the day from chequing or demand deposit accounts to non-reservable money market accounts (MMDAs). While the decline in operating balances[48] has not as yet resulted in a sustained rise in volatility, banks have shown signs of greater reluctance to arbitrage over the maintenance period.[49] Admittedly, the periodic announcements of the federal funds target should limit the concern that the volatility in the overnight rate could cloud policy intentions. Nevertheless, higher volatility could potentially impair the smooth functioning of financial markets more generally.

The recent US experience is a reminder that the "buffer" role of reserve requirements depends to a considerable extent on banks' willingness to arbitrage over the maintenance period. The observed impact of averaging on the stability of the interbank overnight rate is a clear indication that this arbitrage occurs. Nevertheless, especially at system-wide level, there are constraints to the deviations of reserve balances from the average requirement. In fact, central banks typically have a good idea of "normal" fulfilment patterns and, in the absence of special considerations, would not engineer substantial deviations from these (Graph 3.4).[50] The very existence of such patterns, combined with banks' knowledge of the daily situation, is what allows some central banks to use deviations from them as a possible low-key signal of changes in the monetary stance (Section 5).

4. The supply of bank reserves: liquidity management

Consistently with the wish to develop more flexible and less intrusive implementation procedures, central banks have over the years increasingly relied on market operations to balance demand and supply in the market for bank reserves. Together with the trend reduction in reserve requirements and the growing integration of capital markets, this has progressively led to greater liquidity management activism. In turn, this has put a premium on accurate forecasts of the

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46 Total reserve requirements have fallen from some FF 80 billion in 1990 to FF 20 billion at the time of writing; as much as FF 13 billion is held in the form of vault cash, which was first included in the requirements in October 1990.

47 It has not been uncommon for smaller institutions to be able to do so.

48 Over and above the reserve requirement, banks also precommit to hold on average over the maintenance period an amount of clearing balances ("required clearing balances"). The incentive to do so takes the form of rebates on certain central bank services. The Fed cannot pay interest on reserves.

49 In particular, they seem less willing to accumulate excess reserves early in the two-week maintenance period, presumably because of the greater risk of incurring overnight overdrafts later in the period when attempting to work the excess reserves off.

50 In France, for instance, banks normally underfulfil the requirement during most of the maintenance period – generally the initial 25 days – and compensate for this delay towards the end (Graph 3.4). This behaviour is reported to be insensitive to interest rates.

autonomous supply of bank reserves and of the banking system's demand for them, as determined by working balances or reserve requirements.

4.1 Forecasting liquidity

Central bank liquidity forecasts invariably represent the initial stage of policy implementation. They form the basis for decisions regarding the volume, maturity and frequency of operations designed to balance the market. The features of the forecasting process vary considerably from country to country, reflecting a mixture of tradition and specific elements of the operating framework (Table 4.1).

In countries where reserve requirements are in place, central banks tend to match the *main* forecasting horizon with the maintenance period,[51] in order to get a measure of the cumulative impact of autonomous factors and of the baseline demand for bank reserves.[52] The forecasts relate to the daily impact of individual factors, thereby helping to determine the need for, and maturity of, rough and fine-tuning operations. In some countries without reserve requirements and averaging provisions, while paying a great deal of attention to the outlook for the current day,[53] central banks forecast even further ahead. This is the case in the United Kingdom and Australia, where, compared with other countries in the same group, less use has been made of inbuilt buffer mechanisms such as standing facilities. This puts a premium on active and pre-emptive liquidity management, through very flexible maturities (Australia) or the frequency and variety of operations (United Kingdom).

The main forecasts are generally revised daily, although the information regarding the net liquidity position for the maintenance period as whole may be acted upon only at the time of the subsequent regular tender operation (e.g. Germany). Intraday revisions are also possible if the central bank may operate more than once a day, as is routinely done in the United Kingdom.

Except for countries focusing on exchange rate commitments and at times of serious exchange rate pressures, foreign exchange intervention is not a major source of variability in the *autonomous liquidity position*. Moreover, given the two-day settlement lag of foreign exchange transactions in most markets, it is known with certainty within the horizon of daily operations. While certain countries appear to have some difficulties in forecasting cash, notably Japan, commonly the most troublesome item in terms of both variability and forecastability is net lending to the government (same table). In fact, only in Sweden and Austria do the central banks neither lend to, nor hold deposits of, the government. A number of European countries have recently prohibited lending to the government in accordance with the Maastricht criteria in preparation for monetary union, thereby eliminating an at times very constraining source of liquidity, most notably in Italy (Table 4.2). Nevertheless, the variability of government deposits generally remains significant.

Arrangements aimed at limiting the problem vary from country to country (same table). In a number of cases formal or informal mechanisms have been put in place to ensure that surplus balances are invested in the market, including in the United States, Germany and France. One such scheme is under study in the Netherlands. In Belgium the government is obliged to provide the central bank with a forecast each morning, with significant deviations being penalised through a lower remuneration. In some other countries information is sufficiently accurate and prompt to defuse the issue, notably in Spain. On the other hand, an active and independent management by the government of its surplus funds in the market could also potentially interfere with monetary policy implementation by virtue of the sheer size of the positions or by confounding policy signals. In order to limit this risk,

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[51] In Spain and Italy, it is a multiple of the maintenance period. In the Netherlands, it coincides with the quota scheme period.

[52] In France, the main horizon is determined by the maturity of the twice-weekly tender.

[53] In Australia, the current and the following day are equally important given that certain participants can choose the settlement date (T or T+1).

Table 4.1
Features of the forecasting process

	AU	AT	BE	CA	FR	DE	IT	JP	NL	ES	SE	CH	UK	US
Horizon(s)	2m(r)[1]	1m(c)	10d(r)[1]	1d[2]	1d/8d[3]	2m(c)	2m(c)/1y(c)	1d[4]/1m(c)	1d/3m(c)	1d/60-80d[5]	1w(r)	5d	1d/13w(c)[6]	2w
Maintenance period[7]	1d	1m	1d	1m	1m	1m	1m	1m	3m[8]	10d	1d	1m	1d	2w
Forecast interval[9]	1d	1d	1d	1d	1d	1d	1d[10]/1m	1d/1m	1d	1d[11]	1d	1d	1d	1d
When made	daily	daily	daily	daily	daily/ 2 x w	daily	daily/ Sept.	daily/ end-m	daily	daily/ regularly[12]	daily	daily	daily	daily
Revisions	intraday	daily	daily	daily	daily	daily	2 x m and daily	intraday/ mid-m	daily	1 x 10d	daily	intraday	intraday/ daily	daily
Most unpredictable item	G[13]	-	C	-	F	C, F	G[14]	C, G	G	G[15]	G, C	G	G[16], C	G, C
Publication of forecast	*						/*[17]	*[18]					*[19]/	[20]
Modelling excess reserves														*
Request on target balances				*[21]	[22]							*[22]	*[23]	[24]

Key to symbols: r = rolling; c = calendar; C = cash; F = float; G = government; RR = reserve requirement.

[1] Particular attention to the current and following days. [2] Two months for debt management operations as government agent. [3] The second forecast corresponds to the twice-weekly tender, for the duration of the refinancing; in addition, separate reserve forecasts. [4] Daily prospect for next-day and provisional for the current-day position at 5.30 p.m., both partly based on banks' estimates; final balance for the current day reported at 10 a.m. on the following day. [5] In addition, forecast of reserve path for required reserves for two calendar months updated once a month when information on starting-point becomes available. [6] Most attention is given to the fortnight ahead. [7] Set at one day if no reserve requirements or averaging are in place. [8] Quota scheme. [9] Time-unit of forecast. [10] Consistently with the forecast for the year, first bi-monthly and then daily breakdown. [11] Focus is on cumulative position at the end of the period. [12] Beginning of the calculation period. [13] Because settlement for day T transactions takes place at T+1, only currency is not fully known on the relevant day but the corresponding flows are relatively small; the government position is the main item causing errors to the forecast for the next day. [14] But known by noon, in time to make offsetting operations for the day. [15] For horizons longer than one day, because of debt management operations. [16] For daily operations, otherwise good information on debt management. [17] Only the initial yearly forecast. [18] Except revisions to daily and monthly forecasts. [19] Only the forecast for the current day, including revisions, published at the time of each eligible bills tender during the day. [20] Immediately after the end of the maintenance period, the central bank reports the days on which large forecast errors have been made. [21] Twice a day, known as "desired" end-of-day balances (in the morning) and "projected" end-of-day balances (before the clearing). [22] Informal. [23] Practice terminated owing to biases. [24] Occasionally.

Table 4.2

Relationship with the Treasury:[1] lending and deposits

	Lending	Deposits						
		All	**Only part**	**Advance information**	**Target balance[2]**	**Penalty**	**Central bank discretion**	**Remuneration**
AU		*		*				*3
AT				-	-	-	-	-
BE			*	*4		*4		central rate[4,5]
CA			*	*			*6	*7
FR	*8	*		*9	10			tender rate
DE			*11	*12	13		*13	
IT	14	*		*15	16			Treasury bill rate
JP	*17	*		*				
NL				*	18			tender rate
ES			*	*19				tender rate
SE				-	-	-	-	-
CH	*20		*	*21	22	-	*21	*23
UK	*24	*						*25
US			*	*26	*27			

[1] In certain cases, other sectors of the public administration are also involved. [2] Or similar arrangements aimed at making balances more predictable. [3] Target cash rate minus 0.10%. [4] Daily obligation (9.15 a.m.) for the Treasury to provide a forecast for the current and following two days; the remuneration is lowered if the error exceeds a certain amount. [5] Up to a ceiling. [6] Shifts in demand balances are the key liquidity management tool; surplus balances auctioned to direct clearers, typically for one to seven-day periods (typically one business day). [7] Below market rates on operating deposits (given their use in the cash setting); market rates on the remaining portion. [8] To be phased out by the end of 2003. [9] Daily forecasts for the maturity of regular tenders. [10] Policy of investing excess balances in repos with primary dealers to smooth out variations. [11] In 1994 the requirement to hold all liquid funds with the Bundesbank was abolished. [12] Joint central bank/Federal Government estimates. [13] Surplus funds invested by the Bundesbank in the market; tool for fine-tuning prior to 1994. [14] No lending since end-1993, until then lending facility up to 14% of budgeted expenditure at a 1% interest rate. [15] Usually known by noon. [16] A number of safeguards to prevent balances from falling too low. [17] Possible according to the Bank of Japan Law but no lending has actually taken place since 1960. [18] Only informal arrangements. [19] Stable distribution and accurate real-time information. [20] Credit line subject to a collateralised credit line, on lombard terms; credit granted only if the Treasury is unable to obtain funds from the market. [21] Estimate available at 2.15 p.m.; the central bank is willing to operate until 3 p.m. to neutralise the impact; transfers of time deposits are used in fine-tuning before 3 p.m. [22] Agreement with the Treasury that it refrains from investing in the overnight market. [23] Current account remunerated at the overnight rate (up to a ceiling); investment account roughly at market rates. [24] Overnight "ways and means" advance; it would have to be phased out if the United Kingdom joined EMU. [25] At market rates. [26] Joint central bank/Treasury estimates. [27] US$ 5 billion (US$ 7 billion around tax payment dates).

the Swiss National Bank has an agreement that does not permit the Treasury to invest its surplus funds in the overnight market.

As regards the forecasts of the *demand for bank reserves*, it is useful to distinguish between projections of the reserve requirement and of working balances. Where reserve requirements are semi-lagged or almost contemporaneous, considerable efforts are devoted to forecasting the reserve requirement itself. This is done on the basis of the expected change in eligible liabilities (essentially deposits), typically through formal models and surveys. In Germany, since the amount of reserve requirements to be held does not become known until around one week before the end of the maintenance period, sizable adjustments may be needed; the Bundesbank bases its initial projection on the target path for M3. In the United States, the demand for excess reserves is also partly modelled. More commonly, the central bank makes judgemental estimates of "typical" patterns of accumulation of reserves during the maintenance period. Where working balances are the binding constraint on the demand for reserves, central banks usually estimate liquidity needs simply by contacting banks, generally informally. This procedure has been an integral part of daily liquidity management in the United Kingdom[54] and Canada.[55]

Most central banks do not make their forecasts *public*. The main exceptions are Australia, the United Kingdom and Japan.[56] Publication is intended primarily to facilitate the liquidity management of banks and, most notably in Japan, to help convey policy intentions revealed by comparing the forecast with the amount of liquidity actually provided or withdrawn (Section 5). In the other countries it is generally felt to be either unnecessary, because of the presence of automatic stabilisers, or inappropriate, not least where estimates are subject to significant error. Attitudes towards the value of disclosure, however, are evolving (Section 5).

4.2 Discretionary market operations and standing facilities[57]

Discretionary market operations are now the main instrument for managing liquidity. The only exception is the Bank of Canada, which relies almost exclusively on transfers of government deposits between the central bank and clearers. In this case, the impact on bank reserves of market operations such as reversed transactions or Treasury bill sales is routinely sterilised; their main role, therefore, is signalling (Section 5).

As outlined in Section 3, market operations nowadays are typically geared to balancing the market for bank reserves as a whole. Banks, that is, would not normally be expected to rely on standing facilities, except those provided at subsidised (below-market) rates, unless the central bank made a mistake in forecasting liquidity conditions, inefficiencies in the system prevented a smooth redistribution of reserves or bank-specific factors were at work. The implication is that standing facilities at non-subsidised rates have increasingly played the role of "safety valves" rather than being key mechanisms for setting the marginal interest rate for the market as a whole (Tables 4.3 and 4.4).

How far this strategy is strictly pursued varies across countries and circumstances. At one extreme, Austria has only recently been moving in this direction, with the introduction of regular tender operations in late 1995. Until then, liquidity was regulated almost exclusively through standing facilities. The wish to bring the system closer to the typical European configuration with a view to participating in stage three of monetary union has no doubt played a significant part in this decision. Similarly, systems where the market has to balance each day owing to the absence of reserve

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54 The Bank of England has stopped doing so after noticing a persistent downward bias in the declared targets. Since then, it has simply adjusted previous targets downwards.

55 The Bank of Japan also contacts the major banks directly in order to ensure the smooth running of the interbank net settlement systems that settle three times a day.

56 Italy publishes only its annual forecast of monthly movements, which is then used as basis for deriving a consistent initial set of forecasts at higher frequencies.

57 More detailed information on certain aspects of standing facilities and market operations can be found in Annexes III and IV.

Table 4.3

Standing facilities: market ceiling[1]

	AU	AT	BE(1)[2]	BE(2)[2]	CA(2)[3]	FR	DE	IT	SE	CH	UK(1)[4]	UK(2)
Name	Rediscount	Lombard	Ordinary advances	Hors plafond[5]	Overdraft loans	5 to 10-day repurchase	Lombard	Fixed-term advances	Lending facility	Lombard	Late lending[4]	Clearing banks facility
Pricing												
• posted		*	*[6]	*	*	*	*[7]	*	*[8]		*[9]	
• floating	*[10]									*[11]		
• discretion												*[12]
Suspension possible		[13]	[14]	[14]		*[15]	*	*				
Limits on credit												
• collateral	(*)	*	*	*	*	(*)	*	*	*	*	*	(*)
• quota			*[16]						*	*[17]	*[18]	
• conditions							*[19]					
• discretion		*					*[19]	*			*[20]	[20]
Maturity	≤90d	1d[21]	1d	1d	1d	5-10d[15]	1d	1-32d[22]	1d	≥1d	1d	1-33d
• discretion						[15]	*	*			*	*
Settlement	T	T	T	T	T	T	T	T	T	T	T	T
Functions												
• signalling			*	*	*	*	*	*	*		*[23]	*[23]
• limit rise in rate	*	*	*	*	*	*	*	*	*		*[23]	*[23]
• emergency settlement[1]	*	*		*		*	*	*	*	*		
• other											*[23]	*[23]

Key to symbol: (*) indicates rediscounting, reversed transaction or outright purchase of securities.

Footnotes: See opposite.

Footnotes to Table 4.3

[1] Further information is contained in Annex II; as can be seen from the specific conditions on which credit is granted, the term "market" ceiling should be interpreted loosely. The terms described in the table refer to the normal use of the facilities; in some cases, when the same facility is used also for emergency settlement, terms can be quite different (see Table 3.1). [2] A third facility exists for primary dealers, granted for limited amounts at the central rate within an overall ceiling and individual quotas. [3] In addition, there is a special standing facility for investment dealer-jobbers known as Purchase and Resale Agreements (PRAs). The corresponding credit is granted in the form of reverse transactions, has an overnight maturity, is subject to a pre-determined limit and can be extended only against evidence that the institution has exhausted alternative sources of funds. The amounts granted are routinely sterilised. [4] Covering both the 2.45 p.m. lending facility (discount houses and gilt-edged market makers) and the "late-late lending" (2.45-3.30 p.m.; discount houses only). [5] Refers to those advances beyond the quota that are granted against collateral freely predeposited by banks. [6] Mark-up on central rate (currently 1.25%). [7] Possibility to grant "Special Lombard" loans at a rate set on a daily basis. [8] Surcharge of 1% if the loan exceeds the 4% capital threshold. [9] Official rate (same as stop rate) on first tranche plus 0.50% on each successive one ("2.45 lending"); incremental 0.25% penalty for borrowing within each successive 15-minute period until 3.30 ("late-late lending"). [10] Market rate plus 0.75% capped at the rate on the rediscounting of seven-day Treasury notes, regardless of actual maturity. [11] Overnight rate on previous two days plus 2.0%. [12] Usually higher than market rates. [13] In principle, the central bank can refuse to grant credit under any standing facility without giving any reason. [14] In principle possible, in practice not feasible given vital role in settlement process. [15] Replacement by one-day facility (see Annex V). [16] For the system as a whole and individual banks. [17] Credit line granted to a bank on the basis of the collateral it pledges to the central bank. [18] Quotas and tranche sizes set quarterly in relation to the capital base of the institutions. [19] Should only fulfil temporary liquidity needs; granted only if appropriate and acceptable in terms of size and duration. [20] Aggregate only, in order to balance the market at the end of the day. [21] Before 1996, up to three months. [22] In 1992-94, average of six days. [23] Allows the market to balance after discretionary operations; encourages banks to satisfy their liquidity needs earlier in the day to limit end-of-day volatility; may be used, in conjunction with adjustments in the speed of injection of liquidity, to underline policy signals (Section 5).

Table 4.4
Standing facilities: market floor[1]

	AU	AT	BE	SE
Name	Interest-bearing settlement balances[2]	REGOM (deposit facility)	Deposit facility[3]	Deposit facility[3]
Pricing				
• posted	*2	*4	*5	
Suspension			*3	
Limits				
• quota			*3	*3
• discretion		6		
Maturity	1d	1d	1d	1d
Settlement	T	T	T	T
Functions				
• signalling			*	*
• floor	*	*	*	*

[1] Further information is contained in Annex II. The Bundesbank has on occasion issued very short-term (three-day) "liquidity paper" performing a similar function. [2] Settlement balances earn interest equal to the target overnight rate minus 0.10%; this is functionally equivalent to a permanent deposit facility. [3] Arrangements are a mirror image of those for central bank advances (Table 4.3). [4] At discount rate. [5] Central rate (primary dealers, for limited amounts); central rate minus 1% (first tranche); central rate minus 2% (unlimited). [6] In principle, the central bank can refuse to transact without giving any reasons, as with other facilities.

requirements usually rely more often on such facilities. This, for instance, seems to be the case in Sweden[58] and Belgium. In Belgium, for example, by calibrating the need to turn to the central bank for late-day assistance or to deposit surplus funds, the central bank can put the desired pressure on interest rates. This is also possible in the United Kingdom, where end-of-day assistance is discretionary, but a set of late-day advance facilities at escalating rates has been put in place.[59] Similar strategies are sometimes followed in systems where averaging provisions act as an effective buffer. The Bundesbank, for instance, may resist downward pressure on the overnight rate by allowing reserve positions to be run down and failing to provide enough liquidity towards the end of the maintenance period, raising the impact of the lombard rate.

Against this background, standing facilities at *below-market (subsidised) rates* have lost much of their significance in liquidity management (Table 4.5). In Europe, in the four countries that still retain them, discount facilities almost invariably represent a minor source of basic refinancing. Operations have been virtually discontinued in Switzerland and Italy,[60] are quite limited in Belgium and, in relative terms, have been drastically reduced in Germany, where they now account for less than one-third of central bank refinancing. The only below-market facility still playing a significant role in liquidity management in Europe is that of advances under the quota scheme in the Netherlands. The facility serves as marginal accommodation for the settlement process and, through averaging provisions, helps to limit the volatility in the overnight rate. Its subsidy element, however, is not large.

Developments in the United States and Japan have been rather sui generis. There the main function of the discount windows in liquidity management has traditionally been somewhat different from that of their European counterparts and the loss in importance has occurred largely as a result of events beyond the central banks' immediate control.

In the United States the key function of the discount window in the implementation of monetary policy has been that of limiting pressures on the overnight rate by providing "adjustment credit" to meet reserve deficiencies or avoid end-of-day overdrafts.[61] Given the below-market cost, assistance has been restricted to situations in which the requesting bank cannot find funds at a reasonable cost in the market; in addition, excessive use has been discouraged. In the past, a fairly well-behaved relationship between the demand for adjustment credit and the spread between the overnight rate and the discount rate was a key element in policy implementation, allowing the Fed to gauge the need for market operations to steer the overnight rate. The situation changed in the early 1990s, when a series of episodes of financial distress among banks entrenched the view that discount window borrowing was a sign of weakness. Since then, despite the return to strength of the banking system, this perception has persisted and has resulted in great reluctance to turn to the window, regardless of the market cost of funds. This has complicated reserve management by the Fed and hindered the role of the window as an effective safety valve.

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58 Even so, the central bank's policy in Sweden is to avoid reliance on the facilities as much as possible; their utilisation is frequent but the associated amounts are very small.

59 The number of facilities is partly related to the variety of counterparties, namely discount houses and gilt-edged market makers (GEMMs; 2.45 lending), discount houses (late-late lending, 2.45 - 3.30 p.m.) and clearing banks (2.30 - 3.00 p.m. facility). The quantitative significance of the amounts borrowed, especially under the late facility, is small; the facility for clearing banks is rarely used. The overall amount provided through these facilities has to be limited to what is necessary to balance the market at the end of the day.

60 Italy also has an "ordinary advances" facility, providing current account advances at the discount rate (plus a fee for the facility). Before the introduction of averaging, this facility was actively used to meet working balance needs. Since then, it has declined sharply in importance; a doubling of the fee in June 1991 has been partly responsible.

61 The facility is also used to grant "extended" and seasonal credit, neither of which plays any role in the monetary policy framework.

Table 4.5

Standing facilities: below market[1]

	AT(1)	BE	DE	IT[2]	JP[3]	CH[4]	US[5]	NL	AT(2)[6]
Name	Discount facility	Discount facility	Discount facility	Ordinary advances[2]	Discount window	Discount facility	Discount window	Quota scheme advances	GOMEX
Pricing									
• posted	*	*	*	*[7]	*[8]	*	*	*	*[6]
Limits on credit									
• quota		*[9]	*[10]	*	*[11]	-		*[12]	*[13]
• conditions							*[14]		
• discretion	*	*[15]	[15]	*[16]	*[11]	-			
Maturity	≤3m	15-60d	≤3m	indet.[17]	≥1d	-	1d	indet.[17]	≥1d[18]
• discretion					*[19]				
Settlement	T	T+1	T	T	T	-	T	T	T
Functions									
• signalling	*	*	*		*	*	[20]	*	*[6]
• basic refinancing	*	[21]	*	*[22]				*	
• limit volatility							*	*	
• marginal accommodation					*		*	*	
• other					*[23]		*[4]		*[6]

[1] Further information is contained in Annex III. [2] In addition, negligible amounts of agricultural credit granted through the discount facility. [3] From July 1995 the rate has been above the overnight rate. [4] Regular transactions deactivated; facility left for extraordinary situations. [5] Terms on "adjustment credit" (only to meet reserve deficiencies or avoid end-of-day overdrafts); excludes seasonal and extended credit, which do not perform a monetary policy function. [6] Until late 1995, when regular tenders became the keynote operation, the GOMEX was regarded as the main policy rate and tended to be, on average, below the overnight rate; since then, it has moved above the tender rate. [7] At discount rate plus a fee for the credit line (raised from 0.15 to 0.30% in January 1991 so as to reduce its use). [8] Interest charges calculated on the basis of actual maturity plus one day. [9] Globally, equal to BF 5 billion, allocated among banks according to the size and structure of their liabilities. [10] Based on the liable capital and the structure of the balance sheet. [11] Rationing; full discretion over amounts. [12] Quota set for three-month periods in relation to the institutions' short-term liabilities; also includes a 25% excess borrowing zone. [13] Part of the overall quota for standing facilities (see also Table 4.3). [14] The bank should demonstrate that no market alternatives at reasonable cost are available; it would come under scrutiny if it made "excessive use" of the facility. [15] The central bank can reduce the overall size of the facility, or suspend it; it cannot alter individual quotas. [16] Discretion to grant the line and possibly to suspend it with two days' notice. [17] Current account advance. [18] In practice, mostly one day. [19] In addition, the central bank can recall the loan at any time. [20] Significant role before explicit announcements of the target rate began in February 1994. [21] Limited. [22] Key facility to meet settlement needs before reserve requirements could partly be used for that purpose (buffer role); now used to the full. [23] Has been used as a flexible means of adjusting liquidity until January 1996.

In recent years the Bank of Japan has been the only central bank to employ the discount window as a major tool for active liquidity management. The amount and maturity of credits granted through it are entirely discretionary. Moreover, the Bank can also recall them at will. The window, however, has been ineffective since July 1995. At that time the Bank steered the call rate to fall below the discount rate for the first time and to historically low levels in order to stimulate the economy in the face of generalised weakness in the banking system. This situation has persisted to the present day.

As regards market operations, most central banks have at least one transaction that takes place at *regular intervals* (Table 4.6). The reason is partly related to liquidity management. In the case of countries where reserve requirements are binding, for instance, the timing bears a close relationship to the maintenance period. The aim of the transaction is generally to provide the basic liquidity needs of the system in line with the forecasts over the main implementation cycle. Nevertheless, its significance often goes further. The regular transaction is often the *keynote* operation, the one that sets the tone of monetary policy, where the authorities' intentions are revealed, on which all market attention is focused. The weekly tender of the Bundesbank is a clear example. Central banks not relying on such keynote regular operations, such as the United States or Switzerland, typically convey policy intentions through other channels (Section 5).

Other operations play supporting roles in different ways. One is that of *calibrating day-to-day market conditions* at short notice.[62] This occurs both in countries with and without reserve requirements. In the former, the buffer role of the requirements may not be sufficient, especially when the interval between regular operations is as long as one week or more. In the latter, balancing the market calls for greater attention. Unless the central bank operates regularly at the end of the day, as in Canada, other operations are typically needed. Repos in Switzerland and France and transactions in the interbank market in Belgium and Sweden fall into this category. The significance of this type of operation has greatly increased in recent years, as the need for intervention has risen in line with the reduction in reserve requirements and the greater sensitivity of markets to domestic and international developments.[63]

A second supporting role in liquidity management is that of *gross* (or "*rough*") tuning. Operations of this kind provide liquidity over longer horizons than regular transactions and/or respond to predictable patterns in liquidity not otherwise taken into account, such as seasonal fluctuations or the effects of foreign exchange intervention. Typical examples are outright purchases of government securities in the United States, Japan and France and foreign exchange swaps in Italy.

A third supporting function is that of mopping up excessive liquidity with a view to inducing an ex ante *net liquidity shortage*. This can occur in systems where the keynote operation, by construction, can only be used to *inject* liquidity, a common situation. Such an asymmetry requires a shortage in the market. Unless autonomous factors and reserve requirements, in conjunction with maturing central bank operations, result in a net deficit, the central bank must generate it. This is the function performed by the weekly Treasury bill tender in the United Kingdom, the sale of central bank paper in the Netherlands and foreign exchange swaps in Belgium.

The *maturity* of market operations typically differs across types of transaction, reflecting differences in the functions performed. As a rule, it is comparatively short for regular keynote operations (generally between one and two weeks), shorter for day-to-day calibration and longer for the remaining categories. In recent years, there has been a widespread trend towards a reduction in the average maturity, consistently with the need to increase the flexibility of liquidity management and with the longer-term trend towards leaving greater room for market forces in the determination of

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62 This is the use for which the term "fine-tuning" is probably most appropriate.

63 In order to be effective, these operations must be settled on a same-day basis. Since swaps are generally settled on a T+2 basis, they are hardly used for day-to-day calibration.

interest rates. The reluctance to conduct outright transactions in securities markets is part and parcel of the same attitude.

The choice of *counterparties* is also partly determined by the nature of the transaction (see Annex IV). Regular transactions, given lead times, are generally executed with a broader set of counterparties than irregular ones. Beyond this, the range and number of counterparties vary substantially across countries, reflecting different views regarding the merits of broad participation or of privileged relationships with market-makers[64] and other aspects of the organisation of national money markets. At one end of the spectrum is the United States, where the Fed deals only with a restricted group of primary dealers. At the other end is Germany, where participation in the regular auctions is open to all credit institutions subject to reserve requirements.[65] The United Kingdom is rather special in that each market operation and standard facility has a specific set of counterparties, ranging from discount houses only for the keynote eligible bill operations to no restrictions on participation in the weekly Treasury bill tenders.

The choice of the *method for determining the price* of the transactions is partly affected by the nature of the operation. Foreign exchange swaps, for instance, are mostly done at the ruling market prices quoted on the screens on a bilateral basis. Similarly, the observed differences in preferences for specific types of tender (volume vs. interest rate tender, adjudication at a uniform or varying price) may in part be due to varying views regarding their technical merit. Nonetheless, probably the most important consideration is the clarity of the signal associated with the various techniques (Section 5).

As regards the *type and number of instruments* employed, the most remarkable development in recent years has already been discussed in Section 2, viz. the increasing reliance on reversed transactions. Beyond this, Table 4.6 reveals a great variety of approaches across countries. The spectrum ranges from countries where at most one type of operation is sufficient for liquidity management, such as Canada, to those relying on a broad range of transactions, such as Japan and the United Kingdom.

The range of underlying securities traded and collateral accepted varies considerably across countries. This reflects, inter alia, the relative availability of the various assets, settlement characteristics as well as broader legal and historical factors. In Japan and several European countries, notably the Netherlands, Germany, France and Austria, the range is quite broad, including various types of public as well as private claims. By contrast, in the United States, Canada and Australia, the central bank operates exclusively on the basis of public sector assets. Under normal conditions, the availability or distribution of eligible assets in not a constraint on policy; the United Kingdom has possibly been an exception in this regard, given the traditional practice of dealing with discount houses in commercial bills, the issuance of which has not kept pace with the growth of bank balance sheets in recent years. However, at times when exchange rate commitments are tested, collateral constraints can have a first-order impact on policy (Annex V).

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64 These would include, for instance, facilitating the development of markets and/or reducing the risks faced by the central bank.

65 Practice in France represents an interesting attempt to strike a balance between operational efficiency and participation. In the twice-weekly tenders, all banks can bid but the bids are channelled through a few principal market operators (OPMs).

Table 4.6a

Discretionary operations

	Type	Underlying instruments	Impact on liquidity	Maturity	Frequency	Settlement	Allotment/ pricing	Function				
								Basic refinancing	Gross tuning	Day-to-day calibration	Creation shortage	Other
AU	RT	Government securities	+/-	av.≈7d	1 x d (R)[1]	T	V(A)	*[2]		*[2]		
	OT	Government securities	+/-	≤1y		T	V(A)	*[2]		*[2]		
	FXS	US$	+/-	variable	occasional	T	bilateral	*[2]		*[2]		
AT	RP	Gov. and private securities	+	1w	1 x w (R)	T+1	F[3]	⊗				
	FXS	DM	+/-	av.1w	as needed[4]	T+2	set rate		*			
BE	RP/CL	Trade bills/gov. securities	+	1w (n)[5]	1 x w (R)	T+2	F[6]	⊗				
	I	Loans/deposits	+/-	1d	1 x d	T	bilateral			*		
	RP	Government securities	+	3d (n)		T+1	V(A)			*		
	FXS	US$, DM	+/-	1w-1m(n)	occasional	T+2	bilateral		*		*	
	OT	Treasury certificates	+/-	1-3m(n)	occasional	T+2	bilateral		*			
CA[7]	TGD	Demand deposits	+/-	1d	1 x d (R)	T-1	-			⊗		
	RT	Gov. securities[8]	+/-	1d	as needed[8]	T	F					
FR	RP/CL	Gov. and private claims[9]	+	1w	2 x w (R)	T+1	F	⊗				*[10]
	RT	Gov. and private claims[9]	+/-	1d-1w	as needed	T+1	bilateral		*			
	I	Unsecured deposits	-	1d	as needed	T	bilateral			*		
	OT	Treasury bills	+/-	av.≈3m	as needed	T+1	bilateral	*	*			
DE	RP	Gov. and private securities[11]	+	2w	1 x w (R)	T+1	V(A)/F	⊗				
	RP[12]	Gov. and private securities[11]	+	2-10d	as needed	T	V(A)/F		*			
	S	Liquidity paper[13]	-	3d	as needed	T	set rate					*[14]
	FXS	US$[15]	+/-	≥1d	as needed	T+2	bilateral		*			
IT[16]	RT	Government securities	+/-	≤1m	≈ 1 x 5d	T	V(A)	⊗[17]	*			
	FXS	DM/US$	+/-	1m/3m	as needed[18]	T+2	V(A)	*	*			
	OT	Treasury bills	+/-	2-6m	as needed	T	V(A)	[19]	[19]	*		

Key to symbols and footnotes: See page 334.

Table 4.6b
Discretionary operations

	Type	Underlying instruments	Impact on liquidity	Maturity	Frequency	Settlement	Allotment/ pricing	Function				
								Basic refinancing	Gross tuning	Day-to-day calibration	Creation shortage	Other
JP	RP	Bill purchases[1]	+	≤3m[2]	≤2 x d	T/T+1	V(A)	*	*	*		
	RP	Treasury bills	+	variable[2]	≤2 x d	T/T+2	V(A)	*	*	*		
	RP	Government bonds	+	variable[3]	as needed	T+2	V(A)		*			
	RP	Commercial paper	+	≤3m[4]	as needed	T+2	V(A)		*			
	RRP	Financing bills	-	≤2m	as needed	T/T+1	set rate		*			
	S	Central bank bills	-	≤3m[5]	as needed	T/T+1	V(A)		*	*		
	OT	Government bonds	+	9-19y	as needed	T+3	V(A)					*[6]
NL	CL	Very broad range[7]	+	2-8d	≈1 x 4d[8] (R)	T	F	⊗				
	CL	Very broad range[7]	+	variable	as needed	T	F		*			
	S	Central bank paper	-	6m	1 x m (R)	T+3	V(D)				*	
	FXS	DM, US$	+/-	<10d[9]	as needed	T+2[10]	bilateral		*[9]			
	I	Loans[11]/deposits	+/-	1d (n)	as needed	T	bilateral			*		
ES	RP	Government securities	+	10d	≈1 x 10d (R)	T+1	V(A)	⊗				
	RT	Central bank paper	+/-	1d	≈ 1 x d[12]	T	V(A)			*		*[13]
SE	RT	Central bank paper	+/-	1w	1 x w	T+1	F/V(A)	⊗				
	I	Loans/deposits	+/-	1d	as needed	T	bilateral			*		
CH	FXS	US$	+/-	2-4m(n)[14]	≈1 x w	T+2	F	*	*			[14]
	RT	Treasury bills	+/-	1d-1m	} 1 x d	T	bilateral			*		
	TGD	Time deposits	+/-	1d-6m		T	bilateral			*		
UK	OT[15]	Eligible bills[15]	+	1-33d	≤3 x d	T	V*(A)	⊗[16]		*		
	RP	Gilts[17]	+	2-3/4-5w[18]	2 x m(R)	T	F		*			
	S	Treasury bills	-	3m (n)	1 x w (R)	T	V(A)				*	
	S	Treasury bills	-	≤7d (n)[19]	occasional	T	V*(A)		*			
US	RT[20]	Government securities[20]	+/-	1-15d	several x 2w	T	V(A)	*	*	*		
	RP[21]	Government securities[21]	+	1d	several x 2w	T	V(A)	*[22]	*[22]	*[22]		
	OT	Treasury bills (mainly)[23]	+/-	<1y	5-10 x y[24]	T+1[25]	V(A)	*	*			

Key to symbols and footnotes: See page 334.

Key to symbols to Tables 4.6a and b

(n) = normally; F = fixed rate (volume) tender; V = variable rate (interest rate) tender; V* = pre-announced volume and/or minimum rate; ⊗ = keynote operation (basic refinancing and significant signalling content); (A) = American style; (D) = Dutch style.

Footnotes to Table 4.6a

[1] One or the other, once a day, but occasionally both. [2] Distinction difficult given the absence of reserve requirements or averaging; swaps used as a substitute for the other operations. [3] V(A) not excluded. [4] In principle possible, but not used for the last two years. [5] On occasion, 15d or 1m. [6] As a rule, at the central rate; occasionally V(A). [7] Until mid-1995, also sales of Treasury bills to signal views about the three-month rate. [8] Known as Special Purchase and Resale Agreements (SPRAs) and Sale and Repurchase Agreements (SRAs); normally transacted at 9 a.m., their impact on the end-of-day liquidity position is typically sterilised via the redeposit/drawdown facility to achieve the target overnight interest rate; used to signal and enforce the operating band. [9] Government securities and commercial paper for repos; bank claims on companies with favourable credit rating by the Bank of France (maximum residual maturity of two years). [10] To set the lower limit for the overnight rate. [11] Including, inter alia, certain debt securities traded on the stock exchange. [12] So-called "quick tenders". [13] Paper issued by the Federal Government on request by the Bundesbank, which is economically liable for it. [14] Acts as a floor to the overnight rate, when appropriate. [15] Swaps used almost exclusively to increase liquidity and repurchase transactions to drain it. [16] In addition, a number of bilateral reversed and outright transactions with primary dealers in the bond market to improve the market's functioning or occasionally to limit sharp fluctuations in bond prices; the impact on liquidity is sterilised. [17] Limited signalling role reinforced by quantity signals (see Section 5). [18] In 1995, between one and two operations per month in US dollars and between two and three in Deutsche marks. [19] Alternative to repos when the size of the operation is very small.

Footnotes to Table 4.6b

[1] Bills issued by financial institutions (secured by corporate bills or government bonds). [2] Usually 1d-3w. [3] Usually 1w-3m. [4] Usually 3-4w. [5] Usually 1-4w. [6] Regular purchases of government bonds in fulfilment of the legal obligation to supply base money to support economic growth. [7] Including government and (good quality) private paper, mortgage bonds, listed shares and subordinated paper, and required reserves. [8] On average, schedule not fixed. [9] Normally used until the level of the reserve requirement can be changed; the maturity is chosen accordingly. [10] T+1 (Tomorrow/Next) operations possible in limited amounts. [11] Collateralised. [12] Occasionally, up to three times per day. [13] May be used for signalling (see Section 5). [14] Longer maturities (up to 12 months) for signalling purposes (see Section 5). [15] Treasury bills and eligible bank bills, i.e. bills accepted by an eligible bank, denominated in sterling, for an original maturity not exceeding 187 days and subject to certain other restrictions. Supplemented (irregularly) with bill/floating rate gilt repos of 2-3w maturity when the required volumes are unusually large. [16] The tender has lost some of its signalling significance since changes in official rates have been announced separately. [17] Including also UK government marketable debt in currencies other than sterling. [18] Institutions can choose between the two maturity tranches. [19] Could be up to three months. [20] System repurchase agreement (injection), Matched Sale-Purchase agreement (withdrawal); against Treasury and Agency securities (injections) and Treasury bills (withdrawals). [21] Customer repurchase agreement, against Treasury bills or coupons. [22] Usually to address comparatively small shortages. [23] Treasury bills or coupons (purchases); in practice, Treasury bills only (sales). [24] Sales more infrequent. [25] Regular or skip-day.

5. The supply of bank reserves: signalling and tactics

It is probably not an exaggeration to say that at the heart of monetary policy implementation lies not so much liquidity management per se but the *communication strategy* through which the central bank conveys its policy intentions ("signalling"). The technical reasons for this were outlined in Section 1, viz. the very low, if any, interest elasticity of (a possibly unstable) demand for working balances and the importance of expectations about future very short-term interest rates in cases of binding reserve requirements with averaging provisions. In this context, signalling is indispensable to achieving interest rate objectives and limiting volatility.

5.1 How much transparency with respect to operating targets?

At the same time, there are broader economic reasons why communication is now probably more important than ever before. These factors also explain why, on balance, over the last 20 years it is possible to discern a certain pattern in the attitude towards the appropriate clarity of policy signals regarding interest rates.

The initial move towards more market-oriented means of policy implementation away from standing facilities and, in some countries, the greater focus on quantitative objectives for operating and/or intermediate aggregates went naturally hand in hand with implementation strategies where central banks gave less guidance about desired interest rates. At a time when reducing inflation was paramount, these policies were also seen as a way of shielding central banks from social and political resistance to unpalatable increases in interest rates.

With the return of inflation to historically low levels and the emergence of a more favourable political climate, other factors have come to weigh more heavily and to redress the balance towards greater transparency. The increased accountability that accompanies the greater independence of central banks in several countries is one. But most probably the decisive factor has been the rapid development and internationalisation of financial markets in the wake of deregulation and financial innovation. The process has heightened the role of interest rates in the propagation of policy impulses, has made interest and exchange rates highly sensitive to expectational factors and may well have raised the vulnerability of financial markets to sharp movements in rates. It has also brought national central banks, willy-nilly, under the scrutiny of a much broader audience, sometimes less familiar with local market idiosyncrasies in the communication of policy intentions but just as eager to decipher them.[66] Against this background, the need to influence expectations as well as the cost and probability of a misreading of policy have increased.

The gradual shift towards greater transparency in policy implementation, part of a broader process encompassing monetary policy more generally, has been most evident in English-speaking countries. The United States is the clearest example: the move from non-borrowed to borrowed reserves targeting in the early 1980s ushered in a period in which policy signals regarding changes in federal funds rate targets had to be read from a mixture of signals conveyed via market operations and explicit discount rate announcements. Policy became more transparent in the 1990s, as it had been in the 1970s, until finally changes began to be announced in February 1994.[67] The explicit announcement of operating targets in Australia since 1990, (de facto) of changes in stop rates in the United Kingdom since 1992 and of operating bands in Canada since 1994 are part and parcel of the same process.

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66 The Bundesbank has sometimes drawn attention to efforts by new market participants to read too much into purely technical characteristics of its variable rate repo tenders (e.g. amounts renewed relative to those maturing).

67 The fact that the rate had remained unchanged for so long provided a good opportunity to move to a more transparent approach. The new clarity is also consistent with the desire to avoid informational advantages for certain participants.

It is, of course, recognised that the practice of making announcements may have costs. The loss of the ability to effect, and possibly reverse, policy changes in a less visible way is one. The risk of delaying necessary adjustments, especially in the upward direction, is a second. The possibility that it may give markets clear targets to test the resolve of the authorities is a third. It is considerations such as these that have led one country, Switzerland, to seek to retain an operating objective defined in terms of giro deposits. At the same time, considerable day-to-day variations in these deposits are tolerated, the target is not published[68] so as to allow for more leeway and, especially at times of turbulence in the markets, interest rate signals are employed (see below). Moreover, the policy has had to be temporarily abandoned on a number of occasions since the late 1980s, as is the case at present.

5.2 Varieties of signalling strategies

Signals come "in all shapes and sizes" (Table 5.1). Their characteristics depend on the strength, clarity and nuances with which central banks wish to convey their policy intentions and on available instruments.

Nowadays, with the exception of Japan, the main policy signal is conveyed either through announcements of specific targets for operating objectives or through keynote tender operations. In contrast to policy announcements, the clarity of the signal transmitted through tenders depends on the characteristics of the procedures. It is clearest in *fixed rate (volume) tenders*, where participants are asked to bid at the rate set by the central bank. It may be considerably more ambiguous in the case of *interest rate tenders* with ex post published marginal interest rates.[69] In this case it is more difficult to distinguish whether the outcome reflects the acceptance of minor fluctuations around a desired level, the beginning of the implementation of a change in a certain direction or difficulties on the part of the central bank in reconciling the interest rate bids with its liquidity management objectives.[70]

Among the countries using keynote tender operations to convey signals, the picture is rather varied. Three countries, the Netherlands, Belgium and Austria, employ exclusively fixed rate tenders.[71] Sweden and Germany shift between techniques depending on circumstances. In Sweden fixed rate tenders are used to convey clear signals about policy changes while variable rate auctions are relied upon primarily when market rates fluctuate around levels in line with policy intentions. In the past, the Bundesbank had shown some preference for variable rate tenders, seen as more consistent with a hands-off, market-oriented policy.[72,73] It has, however, resorted to fixed rate auctions when the

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68 This is not inconsistent with policies in other countries: less transparency about a quantitive target allows greater room for smoothing out undesired changes in interest rates.

69 There is no policy signal if the central bank does not publish the interest rates at which the bids are met, which is typically the case when the operations have an exclusive liquidity management function.

70 A further distinction is between interest rate tenders in which allotments are made at a common rate ("Dutch method") and those in which they are made at the individual rates bid by participants ("American method") (see table). The choice between the two has more to do with technical characteristics such as their impact on central bank revenue than with signalling policy.

71 In Austria, the central bank does not rule out the possibility of using variable rate tenders but has not yet done so. In Switzerland, the central bank actually sets the rate on its swaps through quasi-auctions, albeit as close as possible to the market level. This is partly to avoid the risk of collusion, given the highly concentrated nature of the banking system (only three major banks).

72 In December 1992 the Bundesbank reduced the size of bidding steps from 5 to 1 basis point. This was designed not only to increase the differentiation in bids, but also to prevent the concentration of bids around a given level, which in effect would make the variable rate tender resemble more closely a fixed rate one.

73 Another useful function of variable rate auctions is to provide the central bank with information about the dispersion of market views about policy and/or liquidity conditions.

Table 5.1
Signalling mechanisms

	AU	AT	BE	CA	FR	DE	IT	JP	NL	ES	SE	CH	UK	US
Interest rate signals														
Announcement of target	*			*1				2					3	*
Regular tender		*	*		*	*	*4		*	*	*		*3	
• Fixed rate		*5	*		*	*5			*		*5			
• Variable rate		*5				*5	*4			*6	*5		*3	
Other market operations				*1	*					*6				
Standing facilities		*	*7		*	*	*	*	*		*	*8		
Other													9	
Quantity signals														
End-of-day positions			*	*10		*								
Intraday injections													*	
Reserve accumulation						*11	*4							
Other						*12		*13						
Maturity								*14				*15	9	

[1] Announcement of operating band for the overnight rate. [2] Since July 1995, explicit indications about the desired average level of the overnight rate. [3] Following the introduction of the new monetary framework in the autumn of 1992, the Bank of England began to announce changes in official rates, applying in particular to the daily eligible bills variable rate tenders (stop rate). [4] Weak signals via variable rate tenders with pre-announced quantities; speed of reserve accumulation (published daily) underlines the signal. [5] Switch to fixed rate tenders to strengthen signals. [6] In order to change the rate, the central bank either repeats the tender (if bids are inconsistent with the policy rate) or prepares the ground on previous days through fine-tuning operations. [7] In particular, central rate. [8] Rate on deactivated discount facility. [9] Until the introduction of the new monetary framework, 2.30 lending: when instituted, this replaced the usual 2.45 p.m. lending facility, and was done at a longer maturity than overnight (typically one week), e.g. to reinforce prevailing rates against expectations of a cut. [10] Cash setting (redeposit/drawdown). [11] Published daily. [12] Lombard credit; published daily. [13] Signalling operations at 9.20 a.m., based on amounts supplied relative to the forecast of autonomous factors. [14] Rarely. [15] Long-term foreign exchange swaps when market rates are seen as too high.

intention has been to give clear signals or to calibrate the pace of decline in market rates, as most recently.[74] The central banks in Italy and Spain rely exclusively on variable rate tenders. In Italy, the comparatively weak guidance for market rates through tenders[75] is supported by low-key quantitative signals (see below) and highly visible changes in the discount rate. By contrast, the Bank of Spain does not use either form of signal. In this case some technical difficulties may arise when the central bank wishes to change policy and participants are taken by surprise.[76] The central bank either prepares the ground through fine-tuning operations conveying interest rate signals on previous days or simply calls for a second auction immediately after the first and in effect announces the minimum rate.

A potential drawback in using *regular* tenders to convey policy messages is that they cannot provide any direction in the periods between auctions when changes are needed. The issue is especially relevant for countries with exchange rate commitments, where reactions to market developments have to be immediate. In this case a possible solution is to rely on interest rates on standing facilities, which can be changed at any time.[77,78] More generally, these rates can be used to reinforce or validate policy changes effected via tenders, especially where such signals may be less clear, as where variable rate tenders are employed. In certain countries, the practice of taking discount rates as a basis for setting administered bank loan rates reinforces their significance. By and large, however, with the increased prominence and visibility of tender rates and the practice of announcing operating targets, the role of standing facilities as signalling mechanisms has diminished.

Japan is the only country which nowadays arguably uses a *quantitative* signal as a key mechanism for steering an interest rate operating target, with the discount rate sometimes acting as an important reinforcing device. The central bank makes public its forecast of the net liquidity position of the system for the following day and announces the volume of operations for that day. Under normal conditions, the gap between the two would provide an idea of the degree of desired tightness or easing.[79] Since March 1995, however, the central bank has been more transparent regarding desired levels of the overnight rate, announcing roughly the average rate that it would like to see in the market, with the discount rate continuing to perform a reinforcing role.[80]

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74 When the Bundesbank wishes to give strong guidance to market rates, it may even announce in advance that the prevailing tender rate will also apply at the next auction.

75 In contrast to most other central banks relying on variable rate tenders, the Bank of Italy pre-announces the volumes to be auctioned. This could allow the central bank to provide a strong signal, by sharply cutting down on the percentage allocated below a specific (marginal) rate. This, however, is only very rarely done.

76 The situation was similar in the United Kingdom until the introduction of the new monetary framework following the departure from the ERM in September 1992. Analogous problems led to the practice of announcing a Minimum Lending Rate (MLR) for the day of the change in policy. This rate would then be taken by the market as the stop (marginal) rate for the new tender. The MLR has a purely symbolic character.

77 In Belgium, in fact, the situation is similar to that in the United kingdom. The rate on the weekly tender is itself equal to the central rate, which applies to a standing facility for loans and deposits granted by the central bank to primary dealers.

78 At the limit, if markets learn to anticipate perfectly the reactions of the central bank and policy is fully credible, the desired changes in market interest rates may be brought about automatically by participants. In many respects, this is the situation in the Netherlands, for instance, which has pursued an exchange rate peg with Germany for a long time. In more recent years such market-induced adjustments have also taken place in Belgium.

79 In contrast, the central bank monitors the pace of reserve accumulation relative to its reference path over the maintenance period (the "progress ratio") only to ensure orderly market conditions.

80 In March 1995 the Bank of Japan announced its intention to "calibrate" the decline of the overnight call rate to lower levels. In July 1995 it announced that it expected short-term money market rates to decline on average slightly below the discount rate (an overnight rate below the discount rate was unprecedented). Again, in September 1995, when the discount rate was further cut by 0.5%, a similar announcement was made.

A precondition for effective signalling is that actions not designed to have any policy significance should be clearly recognised as such. This is easier said than done: in principle *any* action taken by the central bank can reveal something about its policy intentions. After all, reading the tea-leaves in order to divine policy changes is a major source of potential profits for participants. This applies as much to speeches and pronouncements as to money market operations. Central bank officials are generally just as careful about what they say in public as they are in attempting to make clear the distinction between purely liquidity management (technical) operations and those designed to set the tone of policy.

There are a variety of ways of making this distinction clear. Present arrangements in the United States seem to be especially suitable: the Fed announces a target for an interest rate in one market (federal funds), operates in another as a price taker (the well-established private repo market) and hardly provides information about these operations. Difficulties may still arise, however, given the previous long tradition of conveying signals through market operations (see below). The main strategy elsewhere also generally relies on the same principles: giving little information about non-keynote operations, acting whenever possible as a price taker in the markets or else transacting at rates consistent with those established at the policy setting stage (Table 5.2).[81]

Distinguishing between policy setting and liquidity management transactions does not necessarily imply relying exclusively on *one* signalling mechanism. Most central banks find it useful to have a variety of possibilities at their disposal. Complementary signalling procedures can be particularly helpful in resisting undesired changes in market rates other than by just keeping the key policy rate constant: the markets may simply interpret this as a delay in policy action. Alternatively, they can be useful to "test the waters": that is, to explore whether the market reaction to a policy change is consistent with the central bank's objectives. This tactic is particularly relevant for countries with exchange rate commitments, when testing whether a policy easing would be tolerated by the markets without unpleasant implications for the external value of the currency. Finally, they may help to underline otherwise ambiguous signals.

Some of these mechanisms operate by pacing the injection of liquidity into the system. Over and above any liquidity effect, the tactics work because participants are aware of what the central bank is doing and have come to understand its intentions. The Bank of England and the Bundesbank, for example, have used similar signals to those adopted by the Bank of Japan: they can bring forward or postpone the injection of liquidity into the system relative to the standard pattern. In the United Kingdom, this would be done within the day, by varying the volumes auctioned at the different times of the day in relation to the announced net liquidity forecast for that day; the end-of-day settlement needs, however, are *always* met in full and participants know that.[82] In Germany, the Bundesbank can do the same over the maintenance period of the reserve requirement (front and back-loading). German banks can monitor the fulfilment of the requirement and the system's recourse to the lombard facility with a one-day lag.[83] In Italy, the pace of reserve accumulation (also published each day by the central bank) helps to clarify the weak signals contained in tender rates. In Canada and Belgium, providing through regular operations more or less funds than

81 In the Netherlands, one reason for issuing central bank certificates at a considerably longer maturity than that of periodic keynote tenders has been precisely to avoid the risk of having the market attach any policy significance to the issue rate.

82 For example, in order to show resistance to signs of undesired pressure on interest rates, the Bank of England could leave the system "short" relative to the normal pattern of daily liquidity injection at the 9.45 a.m. tender. This tactic has not been used recently.

83 In comparison with the signal provided by the Bank of England, that of the Bundesbank is more ambiguous ("noisy"). The Bundesbank does *not* publish the forecast for the average reserve requirement, which becomes perfectly known only on or after the 20th of each month (around one week before the end of the maintenance period). Banks, therefore, make their own forecast. Inducing the system to borrow for some days from the lombard window can strengthen the signal's clarity.

Table 5.2

Disclosed information about market operations[1]

	AU	AT	BE	CA	FR	DE	IT	JP	NL	ES	SE	CH	UK	US
Main/keynote operation(s)	RT, OT	weekly tender	weekly tender	RT	twice-weekly tender	weekly tender	RP, FXS	RT	regular tender	regular tender	weekly tender	FXS	OT[2]	RT
Before														
• quantity	[3]						*	*					[4]	[5]
• interest rate		*[6]	*[6]	[7]	*[8]	/*			*		/*	*	[9]	
• maturity		*	*		*	*	*	*	*	*	*	*	range	
After														
• quantity		*	*		*	*	*[10]	*	*	*	*		*	
• interest rate		-	-	*[7]	*[8]	r^m/-	r^a, r^m			r^a, r^m	r^m/-	-	r^m	
• maturity		-	-		-	-	-	*	-	-	-	-	range	
• allotment rate		*	*		[11]	a/a^m	a,a^m		a	a,a^m				
Other operations	FXS		I, RP, FXS, OT		RT, I, OT	RP, FXS[12]	OT	OT	FXS, I[13]	RT	I	RT	S/RP[14]	OT
Before														
• quantity		-		-			*	*					*[15]	
• interest rate		-		-		/*							/*[16]	
• maturity		-		-		*	*						*/	
After														
• quantity		-		-		[17]	*	*		*[18]			*[19]	
• interest rate		-		-	[20]	r^m/-	r^a, r^m			r^a[18]			*/-	
• maturity		-		-		-	-			*[18]				
• allotment rate		-		-		a/a^m	a,a^m							

Key to symbols: r^m = marginal rate; r^a = average rate; a = overall allocation rate; a^m = allocation rate at marginal bid; x/y = unless otherwise stated, x refers to variable rate tenders; y to fixed rate tenders.

Footnotes: See opposite.

Footnotes to Table 5.2

[1] The table refers to the information regarding market operations made public before and after their completion. See also Table 4.6 for the list of operations. Transfers of government deposits are excluded. [2] Purchases of eligible bills and complementary bill repos. Information regarding occasional Treasury bill sales is similar. [3] The central bank does not announce the quantity but informs the market if it wants to buy or sell. [4] Forecast of the size of the aggregate daily shortage (surplus for Treasury bill sales) announced. [5] Approximate size of customer repos only. [6] Variable rate tenders also possible, but hardly ever or as yet not employed. [7] The intervention rate on SRAs and SPRAs has been announced since January 1996 (through a press release) when it involves changes in the operating band for the overnight rate. Before that, it was not announced but was disseminated quickly among partipants and picked up by news agencies. [8] Pre-announced in certain cases. [9] De facto the minimum rate (maximum for Treasury bill sales) is known since the central bank announces changes in its official rate (Minimum Lending Rate). The rate is only occasionally tested by the market. [10] Only rarely cut significantly relative to pre-announced volumes. [11] Identical for each participant irrespective of the rate at which the bid is made. [12] No information provided on reversed transactions against foreign exchange; the terms below refer to "quick tenders" only. [13] In addition, sales of central bank certificates are conducted through variable rate tenders (Dutch allocation). The six-month maturity has been chosen to avoid giving any signals. [14] Regular Treasury bill tenders and gilts repos respectively. [15] Discount houses have a collective obligation to underwrite the Treasury bill tender at a rate of their own choosing, but the central bank has never called upon them to do so. [16] Fixed rate tender at the official rate. [17] Volumes published only after the end of the maintenance period. [18] Aggregate information on daily fine-tuning operations made public only after market closing. [19] Can be cut in relation to pre-announced volumes. [20] Information provided only if it is desired to give a signal. For instance, in August 1993 the central bank kept an "official" overnight repo rate, which it lowered only gradually.

required to balance the system at the end of the day performs a similar function to the procedure in Germany or the United Kingdom. Typically, there would be a lag of a couple of days until the policy is truly effective since, in contrast to the United Kingdom, the information set up is not as transparent.[84] Once policy returns to neutral, the interest rates remain at their new level, a clear sign of signalling at work.

Other signalling tactics rely to different degrees on prices or maturities. Subtle changes in maturities can be used to resist market pressures on interest rates. The Swiss National Bank, for instance, offers swaps of an unusually long maturity (at market rates) when market rates are seen as too high.[85] The Bank of England has in the past also followed a similar procedure, by on occasion tendering bills only at the longer maturity ranges. Making public the interest rates at which fine-tuning operations take place, when that is not otherwise done, is another possibility; the Bank of France has done so occasionally at times of exchange rate pressure. Sometimes the signal may be a combination of shifts in maturity and announcements of interest rates; 2.30 lending, discontinued since the announcement of changes in official rates, was a case in point in the United Kingdom. Finally, "open mouth" policy may be employed, providing direct guidance through speeches or public statements.

At the same time, relying on a number of signals raises issues regarding potential inconsistencies and hence interpretation problems. Difficulties of this kind have, for example, been encountered in Canada. Before the introduction of the operating band in 1994, the central bank steered

[84] In Canada the few large banks can quickly work out among themselves what the adjustment in liquidity has been; they may find it harder to calculate target settlement balances for the system as a whole. For that purpose they can use a highly publicised formula elaborated by the Bank of Canada which, on average, appears to track behaviour reasonably well. These "cash setting" operations by the Bank of Canada have been the main instrument for steering the overnight rate within the 50 basis point operating band. Given averaging provisions, the mechanism resembles in part that in place in the United Kingdom or Germany. A recent tactic has been to nudge the rate towards the bottom of the band and leave it there for a while to see whether the market is comfortable with the lower level, that is, whether there is no adverse reaction in money and exchange markets. If these remain stable, the central bank then feels free to lower the operating band. Market participants are fully aware of this tactic.

[85] As noted by the central bank, news agencies and reporters usually hasten to find out whether signals were indeed intended.

the overnight rate with a view to influencing the three-month Treasury bill rate, to which the Bank rate, the interest rate on end-of-day overdrafts, was then related through a mark-up.[86] The choice of the three-month rate as operating target reflected the view, still prevailing today, that rates at that maturity played a key role in the transmission mechanism.[87] The Treasury bill rate was also influenced through signals sent through outright operations in the secondary market. As a result of this set-up, it was on occasion difficult to distinguish whether, say, increases in the overnight rate effected through the redeposit/drawdown mechanism were designed to *raise* the three-month rate or simply to *slow down* the pace of its decline, two quite different policy stances. The noisy nature of the signal regarding the overnight rate itself further compounded the problem. The decision in early 1996 to set the Bank rate equal to the upper bound of the operating band was in part intended to avoid any residual confusion about operating objectives.

5.3 Why does signalling work?

It may be somewhat surprising that the core of policy setting is signalling. The earlier analysis would suggest that except in circumstances where liquidity operations are themselves used to send signals or to make marginal adjustments, policy implementation could conceptually be divided into two rather distinct parts. The first, liquidity management, prepares the ground for the setting of policy by neutralising distortions in short-term rates arising from working balance constraints. The second, signalling, influences the operating target. But how can mere announcements have such a critical effect? That they clearly do so is evident from the fact that in some cases policy signals are sent, and market rates change, *without* any liquidity operations ever taking place. The Swiss experience, for instance, is quite telling: the central bank uses a deactivated discount window facility to give guidance to interest rates.

The answer perhaps lies in the fact that as monopolist supplier of settlement balances, the central bank *could*, if it so wanted, set the overnight rate. It could do so by injecting/withdrawing the volume of settlement balances demanded by the market at the desired rate.[88] And, through arbitrage, it could influence rates further along the money market yield curve *for the period in which no further change was anticipated*. The length of time and maturity, of course, would depend on the credibility of the central bank's policy.

This situation is in sharp, and possibly increasing, contrast with what occurs in the foreign exchange market. There, central banks have become progressively less able to maintain exchange rates at levels inconsistent with those seen as acceptable by the markets. The contrast may in part explain why the tendency in foreign exchange intervention in recent years has been, if anything, towards less, rather than greater, transparency: the threat behind the corresponding signal has become less credible. Intervention may have more impact if it is unclear to market participants whether the observed trading reflects a change in market sentiment or policy actions against the grain of expectations. It may also explain why the effectiveness of signalling per se for domestic monetary policy purposes is much reduced at times when exchange rate commitments are tested: it is then that the credibility of the policy stance is most severely questioned (Annex V).

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86 Specifically, the Bank rate was set 25 basis points above the weekly auction rate.

87 The three-month rate is one of the two variables making up the Monetary Conditions Index (MCI), the other being the exchange rate. The MCI is the main variable guiding policy at the strategic level to achieve the inflation target.

88 As long as the exchange rate is allowed to float, technical constraints in the form of, for example, limited collateral are not an issue (Annexes V and VI).

5.4 Choice of maturities and volatility revisited

The foregoing analysis helps to cast further light on the choice of the maturity of the operating target, on the relationship between this and the maturity of operations and on the acceptable degree of volatility in the target rate.

It is no doubt possible to justify differences in the maturity of operating targets across countries in terms of specificities of the structure and workings of national money markets. For example, in the United States one can draw attention to the extensive reliance on overnight financing and to the common practice of using the federal funds rate as benchmark for the pricing of loans.[89] At the same time such differences are, at least in part, the markets' *response* to a policy choice. In other words, it is not just that a specific interest rate is chosen by the central bank because it is objectively important; also, once a rate is singled out as the operating target it *becomes* important. And it becomes so because it is seen as the variable that the central bank attempts to control and hence as a vital piece of information to anticipate its reactions. In Canada, for example, the banks' prime rate has tended to be particularly responsive to the rate targeted by the central bank. Accordingly, in recent years the link with the overnight rate has become stronger at the expense of that with the Treasury bill auction rate.

Similarly, it is equally debatable whether the tendency towards a shortening of the maturity of operating objectives is an entirely deliberate process. Central banks generally recognise that within the money market curve the key rates in the transmission of policy impulses are those at the three-month maturity or beyond. Admittedly, the retreat to shorter maturities is fully consistent with, if not demanded by, the heightened market orientation of policy. Moreover, it also allows the central bank to obtain more, or at least clearer, *information* about market participants' views and expectations. Nevertheless, that information is, fundamentally, only information about views of the central bank's future policy course, seen either as unfettered or under the pressure of events. It can therefore be useful in anticipating and assessing reactions, but ultimately is a reflection of the new constraints under which central banks are operating. In other words, the move to shorter maturities is probably just as much the result of a deliberate policy as of an inevitable process associated with the increased power of markets. Interest rates other than the overnight rate, which depends directly on the supply of settlement balances, are less and less controllable through market operations. The central bank does not have a monopoly over funds availability except in the market for settlement balances. Looking ahead, with the introduction and further development of real-time gross settlement, the shortening of the maturity focus may well not have come to an end (Annex VI).

These arguments also suggest that the link between the maturity of operations and that of the operating target is not as direct as might appear at first glance. Since it is generally not by supplying funds at a particular maturity that an interest rate is controlled, the two can be decided upon largely independently.[90] True, operating at the same maturity can help to underline policy signals, but otherwise is not strictly necessary.[91] The maturity of market operations can thus be left to be decided primarily, if not exclusively, with a view to facilitating technical liquidity management, as is actually the case in most countries.[92]

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89 Similarly, in the United Kingdom longer-term money market rates are targeted on the grounds that banks' base rates are very closely tied to them.

90 The main exceptions are standing facilities aimed at enforcing upper and lower bounds to the overnight rate. In this case, a watertight mechanism would call for identical maturities.

91 It could even be counterproductive if it gave the market the impression that the central bank was indeed trying to peg a longer-term money market rate by adjusting the supply at that maturity. Its effective power to do so could be subject to test.

92 This works as long as the market clearly recognises that the maturity of operations is not intended to have any signalling content. Otherwise, operating at, say, a ten-day maturity might be incorrectly interpreted as a signal that the policy rate would not be changed for that interval of time.

Should volatility matter, and if so, why? That central banks do care about it is abundantly evident from their efforts to reduce it. From the viewpoint of the smooth operation of markets, volatility in short-term rates may be a problem on certain occasions, but it is difficult to judge what the tolerance level of the system may be. In any case, markets seem to have proved quite resilient in dealing with it, if not to have thrived on it. From the viewpoint of monetary policy, the key issue is the extent to which volatility in interest rates may unnecessarily cloud policy intentions, hindering the pass-through of intended policy changes or inducing market participants to see a change when none has actually occurred. It is, therefore, the volatility in the operating objective which is relevant.

The degree of volatility that can be tolerated in policy implementation arguably varies across countries, depending on the features and degree of understanding of signalling strategies. Beyond the technical effectiveness of specific signalling mechanisms, there is an inevitable trade-off between the wish to retain a certain ambiguity in signals and the risk of misinterpretation. Greater ambiguity can by itself generate greater volatility which, in turn, may increase the risk of misinterpretation. The sharp reduction in day-to-day volatility in the Australian overnight rate following the announcement of targets in 1990 and the greater speed with which market rates appear to respond to policy changes are a clear illustration of the potential gains from greater transparency. Whether the potential costs in terms of loss of flexibility and "cover" make such a strategy universally appropriate is much harder to say.

Similarly, announcements of interest rate targets may not be sufficient to pre-empt problems raised by volatility unless the practice is well established. In the United States, for example, protracted day-to-day departures of the federal funds rate from its target can still from time to time give rise to active speculation in the business press and among market watchers about possible unannounced policy changes. It is hard to judge, however, for how long such behaviour might persist and what its material impact on policy might be.

Conclusions

Current monetary policy implementation procedures can best be viewed from two complementary perspectives: as a set of instruments and practices aimed at equilibrating the supply of and demand for bank reserves (*"liquidity management"*) and as a set of mechanisms for communicating the central bank's policy intentions and guiding market rates (*"signalling"*). At the root of this distinction is the wish to focus primarily on interest rates as operating objectives while at the same time to do so without fixing very short-term rates through standing facilities, in line with the preference for a market-oriented approach.

From the standpoint of liquidity management, the trends that best capture the strengthened market orientation of policy are the increased reliance on market operations at the expense of standing facilities – a trend generally dating back to the early 1980s – and the abandonment of residual direct controls. Nowadays, with very few exceptions, standing facilities serve primarily as safety valves and as guideposts reinforcing the communication of the medium-term policy stance. The bulk of liquidity management is effected through market operations.

Partly under pressure from increasingly mobile international capital and owing to the greater focus placed since the early 1980s on exchange rate objectives in several countries, central banks have considerably widened the range of instruments used in their market operations. Among these, reversed transactions, especially against domestic-currency-denominated assets, have become almost without exception the main policy tool. Their principal advantage is flexibility: they do not require a liquid underlying market to be effective and permit the decoupling of the maturity of the injection/withdrawal of liquidity from that of the asset temporarily transferred in the transaction. Mutatis mutandis, outright sales or purchases on secondary markets for securities generally still play a much more limited role. As regards the range of instruments employed by individual central banks, marked differences still exist. Some central banks rely on comparatively few types of operation, others make use of a much broader set of instruments.

Alongside the widening range of policy tools, liquidity management has become much more active: central banks have typically shortened the maturity of market operations, increased their frequency and complemented regular basic refinancing transactions with others taking place as required by changing circumstances. Here again, one factor behind this development in several countries has been the greater weight of exchange rate objectives or constraints. But, more generally, greater activism has been driven by the continuing trend reduction in reserve requirements, notably as a result of domestic and international competitive pressures. In its wake, the marginal demand for bank reserves has increasingly come to be determined by the need for settlement balances rather than by averaging provisions. Since, as a rule, the demand for working balances is highly insensitive to interest rates, central banks have had to be much more present in the market in order to avoid undesired sharp movements in the overnight rate. It is as if, given the peculiarities of the market for bank reserves, central banks could only choose *how* to be present, viz. through imposed stabilising reserve requirements, standing facilities or active market operations, but not the degree of involvement as long as their objective is defined in terms of an interest rate. If, for example, the Bundesbank can still rely on reserve requirements so as to operate in the market often only once a week, several central banks in systems where no requirements are in place have to do so typically more than once a day, notably the Bank of England.

In recent years central banks have further sharpened their focus on interest rates as operating objectives. The only country which in principle still targets bank reserves is Switzerland. Even so, this option has been pursued in a rather flexible manner and on occasion has had to be temporarily put aside, with greater attention being paid to interest rates in order to avoid the risk of throwing policy off course. The general focus on interest rates partly reflects their increasing role in the transmission mechanism in liberalised markets. But it also derives from the conviction that, even where monetary targets are still the fulcrum of policy strategy, a more quantitatively oriented approach in implementation would result in greater volatility in very short-term rates with no gains in terms of medium-term controllability of intermediate objectives.

The sharper focus on interest rates as operating targets has gone hand in hand with attempts to make policy signals clearer. Technically, the reason behind this is precisely the very low interest sensitivity of the demand for working balances and the importance of expectations about future very short-term interest rates where reserve requirements with averaging provisions are binding. These factors make signalling indispensable in order to achieve objectives for very short-term rates. More fundamentally, the process has been driven by broader changes in the political and economic environment, including the decline in inflation to comparatively low levels, a better political appreciation of the merits of keeping inflation low, the move towards greater independence and accountability of central banks and the much-increased influence of market forces and expectations in the formation of interest rates. On the whole, these elements have tended to shift the balance of perceived costs and benefits in favour of greater transparency. Nevertheless, the assessment of the value of increased openness is not universally shared, with some central banks, notably the Swiss National Bank and the Bank of Italy, fearing the loss of flexibility in adjusting interest rates that it may entail.

Alongside the primary signals regarding the basic interest rate objective, most central banks retain other supporting mechanisms. These can perform several functions, including communicating changes in policy when the main signals can only be sent at regular intervals (e.g. through fixed-schedule tenders), testing the market reaction to possible modifications in the policy stance, bringing about a change in the stance in a less obvious way and resisting or encouraging market-induced movements in interest rates. At the same time, these mechanisms appear to be less prominent or less actively used than in the past.[93] This is partly the result of the shift towards greater transparency.[94]

On the whole, the maturity of the interest rates serving as the focus of policy implementation has tended to decline in recent years. In consequence, the overnight rate is now by far the most common operating target. Only a few countries covered in this study retain a focus on longer money market rates, notably the United Kingdom and the Netherlands.[95] Elsewhere, the overnight rate is either perceived as the key policy rate and subject to explicit targets or else, under normal conditions, is not allowed to deviate much from the key policy rates signalled through regular tenders at somewhat longer maturities. Even where the overnight rate is not the focus, in recent years efforts have been made to reduce its volatility where this was considered excessive.

The shortening of the maturity focus in policy implementation is fully consistent with the strengthened market orientation and the wish to extract as much information as possible regarding market participants' expectations from money market interest rates. Arguably, however, it is also another sign of the growing power of market forces in determining asset prices and hence of the increasing constraints under which central banks operate. These, of course, are the very forces that make communication and persuasion, rather than diktat, the only means through which policy can be effective.

Looking ahead, potentially the main structural factors shaping policy implementation are likely to be changes in payment and settlement arrangements. In the immediate future the introduction of real-time gross settlement and tighter risk control mechanisms may well imply only comparatively minor modifications in procedures. These relate mainly to the need to provide intraday central bank credit and to the frequency and timing of operations. Even within such a short horizon, however, a question mark lies over the risk that limits to the availability and efficient redistribution of collateral may be tested at times when central banks need to defend exchange rate commitments: these limits could pose problems for central banks injecting liquidity into the system in order to sterilise outflows, an issue which already emerged during the ERM crisis of 1992. In the longer term, it is possible to envisage a situation in which the ability to settle transactions at any time during 24-hour cycles in the various currencies could effectively blur the clear-cut distinction between overnight and intraday central bank lending. This could call for a redefinition of key maturity intervals and implementation strategies. But this, at least for the moment, is futurology.

93 Moreover, as mechanisms based on the pace of adjustment in the supply of liquidity have become less common, the distinction between liquidity management and signalling has been sharpened.

94 For example, in Germany the recent shift towards fixed rate tenders has reduced the need for back and front-loading.

95 In Europe, other countries not covered here also pay comparatively little attention to the overnight rate, including Denmark and Finland.

Annex I: Sources and uses of bank reserves: some cross-country statistics

Section 1 in the main text presented the stylised framework that generally underlies liquidity management by central banks, breaking down changes in bank reserves into those resulting from autonomous factors beyond the central bank's control and those deriving from central bank influences. It then went on to put forward a taxonomy of policy instruments. In neither case, however, were any actual figures provided. This annex partially fills that gap. It does so only partially because of certain shortcomings in data availability which prevent a proper assessment of the significance of individual factors and instruments.

Basic sources and uses of bank reserves

As examined in Section 4, the most important planning and implementation horizon of liquidity management is the single day. The reason is that the market for bank reserves must balance each day: the impact of autonomous sources of liquidity must be absorbed by inbuilt stabilisers, such as averaging provisions for reserve requirements, or offsetting policy action by the central bank, be it through standing facilities or discretionary operations. The great efforts devoted to forecasting daily influences on liquidity underscore this point.

Unfortunately, publicly available data on sources and uses of bank reserves generally refer to longer horizons, sometimes one week and more often one month. This limitation severely constrains any analysis: it clouds the variability of the various factors and hence their relative quantitative significance; it does not permit a correct examination of the offsetting role of various policy instruments, whose maturity or horizon of operation is normally much shorter; and, mutatis mutandis, it gives too much weight to permanent influences on liquidity.[1] Bearing these limitations in mind, it is nevertheless useful to take a look at the available data within a common framework so as to form an idea of the orders of magnitude involved.

Table A.I.1 illustrates the size and variability of changes in bank reserves for the period 1992-95, measured at a monthly frequency, highlighting the role of net autonomous factors and of the net central bank position according to the breakdown described in Box 1. "Faute de mieux", all the figures are scaled by the stock of currency and bank reserves, a measure of the size of the central bank's balance sheet.[2]

A few points stand out. First, even considering average flows over periods as long as two years (1992-93 and 1994-95), the impact on liquidity of net autonomous factors often changes *sign* within countries. In this sense, the use of the expression "structural position" to refer to the overall effect of autonomous sources of bank reserves hardly seems appropriate. Only in a few cases has the qualitative impact been constant across the two periods: a sizable withdrawal of liquidity is apparent in Australia, Italy, Spain and the United States; an injection is evident in Austria and Sweden. Second, the monthly variability in the net autonomous position is generally several times the average monthly change; the only exception is the United States, where the monthly standard deviation is also the lowest internationally. This variability differs greatly across countries. It is especially high in Sweden,[3] France, the United Kingdom and Spain and comparatively low in Austria, Belgium,

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[1] A very interesting and informative analysis of daily data for European Union countries can be found in Escrivá and Fagan (1996), "Empirical assessment of monetary policy instruments and procedures (MPIP) in EU countries", *Staff Paper No. 2*, European Monetary Institute, May.

[2] It is difficult to think of an appropriate scaling factor for international comparisons. GDP, for instance, seems to be too remote from the issue at hand.

[3] The figures for Sweden, however, should be treated with great caution owing to several discontinuities associated with changes in operating procedures, especially in 1994.

Germany and Switzerland. The relatively low figure for Germany, coupled with the reliance on averaging provisions for reserve requirements, is consistent with the limited use of fine-tuning operations. Third, measured at the monthly frequency changes in working balances/excess reserves are hardly noticeable, which explains why they are not singled out in the table. Finally, the very high standard deviation of bank reserves in the Netherlands is indicative of the active use of adjustments in reserve requirements as a means of offsetting the impact of autonomous sources of liquidity:[4] indeed, the Netherlands is the only country for which this variability exceeds that of the net central bank position.

Table A.I.1
Basic sources and uses of bank reserves[1]

	Net autonomous position		**Net policy position**		**Bank reserves**[2]		***Memo: Standard deviation***[3]		
	1992-93	1994-95	1992-93	1994-95	1992-93	1994-95	*Net autonomous position*	*Net policy position*	*Bank reserves*
	as a percentage of the average level of currency and bank reserves								
Australia	- 1.33	- 2.22	1.44	2.35	- 0.10	- 0.13	*8.1*	*8.0*	*0.5*
Austria	0.44	0.28	- 0.43	- 0.35	- 0.01	0.07	*2.9*	*3.1*	*0.8*
Belgium	- 0.62	0.14	0.62	- 0.14	0.00	0.00	*3.7*	*3.7*	*0.0*
Canada	0.79	- 1.46	0.06	1.42	- 0.85	0.04	*4.7*	*3.4*	*1.9*
France	- 4.11	4.06	3.30	- 4.04	0.81	- 0.02	*30.4*	*31.0*	*2.7*
Germany	- 0.01	- 0.45	- 0.15	- 0.29	0.16	0.73	*4.3*	*4.4*	*2.6*
Italy	- 1.53	- 0.73	1.04	0.03	0.49	0.71	*6.1*	*6.4*	*2.8*
Japan	0.59	- 1.12	- 0.71	1.17	0.11	- 0.05	*7.3*	*7.5*	*0.9*
Netherlands	1.87	- 1.06	- 0.09	- 1.20	- 1.78	2.26	*9.7*	*2.3*	*9.7*
Spain	- 3.65	- 0.12	3.17	0.15	0.49	- 0.03	*13.2*	*13.7*	*3.7*
Sweden[4]	8.00	3.07	- 7.86	- 3.38	- 0.14	0.31	*46.4*	*46.2*	*1.1*
Switzerland	- 0.56	0.57	0.57	- 0.57	- 0.01	0.00	*4.4*	*4.6*	*0.4*
United Kingdom	- 2.74	4.07	2.77	- 4.08	- 0.03	0.01	*14.6*	*14.6*	*0.7*
United States	- 0.72	- 0.55	0.75	0.46	- 0.03	0.09	*0.8*	*1.0*	*0.4*

[1] Average monthly changes. In this and all following tables, + = liquidity injection; - = liquidity withdrawal. For a definition of the terms, see Box 1. [2] Working balances/excess reserves are not shown separately because they are generally negligible. [3] For the period 1992-95. [4] Owing to changes in operating procedures, especially in 1994, the series are not homogeneous.

Source: National data.

Table A.I.2 reports the breakdown of the net autonomous position into its main components, where available, viz., net foreign assets, net lending to the government, currency and other net assets (the residual). These figures should be interpreted with great caution, since the incidence of measurement problems, such as valuation effects, varies across components.[5] Moreover, the influence of net foreign assets is especially difficult to measure correctly, sometimes because central banks are reluctant to reveal information about their exchange market intervention.

4 Of course, a much more useful measure would be the covariance of bank reserves with autonomous factors, measured at a higher frequency. In this case, the inbuilt stabiliser role of averaging provisions could be assessed. See Escrivá and Fagan, op. cit.

5 Often the flow figures are derived from changes in stocks.

Table A.I.2

Breakdown of the net autonomous position[1]

	Net foreign assets		**Net lending to government**		**Other net assets**		**Currency**		***Memo: Standard deviation[2]***			
	1992-93	1994-95	1992-93	1994-95	1992-93	1994-95	1992-93	1994-95	*Net foreign assets*	*Net lending to government*	*Other net assets*	*Currency*
	as a percentage of the average level of currency and bank reserves											
Australia	- 0.83	0.90	7.07	5.98	- 7.15	- 8.62	- 0.44	- 0.48	*3.6*	*7.6*	*7.6*	*2.2*
Austria	1.13	0.71	0.03	- 0.01	- 0.36	- 0.10	- 0.37	- 0.31	*2.6*	*0.1*	*1.2*	*1.7*
Belgium	- 0.53[3]	0.18[3]	- 0.01	0.01	0.01	0.06	- 0.08	- 0.10	*3.0*	*0.7*	*0.6*	*2.5*
Canada	- 0.82	0.54	9.52	- 0.33	- 7.45	- 1.44	- 0.46	- 0.23	*5.5*	*9.0*	*6.7*	*3.9*
France	- 1.90	1.77	- 1.65	2.02	- 0.61	0.37	0.04	- 0.11	*20.0*	*19.1*	*4.4*	*2.8*
Germany	0.71	0.24	0.09	0.10	- 0.24	- 0.42	- 0.58	- 0.36	*4.1*	*1.5*	*1.5*	*1.3*
Italy	- 0.91	- 0.01	- 0.02	- 0.34	- 0.32	- 0.17	- 0.27	- 0.22	*3.0*	*7.3*	*0.8*	*1.6*
Japan	0.21	0.70	0.57	- 1.36	-	-	- 0.19	- 0.47	*1.0*	*6.3*	*-*	*6.8*
Netherlands	2.60	- 0.18	- 0.88	- 1.50	0.19	0.70	- 0.04	- 0.07	*6.9*	*8.9*	*2.1*	*1.0*
Spain	- 0.34	- 0.85	- 1.88	0.90	- 0.92	0.38	- 0.51	- 0.55	*4.4*	*8.1*	*10.0*	*1.9*
Sweden[4]	3.93	- 0.22	3.91	1.27	0.13	2.07	0.02	- 0.05	*21.3*	*40.3*	*11.1*	*3.9*
Switzerland	0.84	0.49	- 0.38	0.15	- 0.94	0.02	- 0.07	- 0.08	*1.8*	*4.1*	*4.1*	*2.2*
United Kingdom	- 1.22	- 0.09	- 2.39	5.46	1.53	- 0.74	- 0.66	- 0.56	*6.3*	*14.9*	*8.9*	*5.8*
United States	- 0.08	0.01	0.03	0.02	0.01	- 0.01	- 0.68	- 0.57	*0.2*	*0.5*	*0.2*	*0.5*

[1] Average monthly changes. For a definition of the terms, see Box 1. [2] For the period 1992-95. [3] Including foreign exchange swaps used to adjust domestic liquidity. [4] Owing to changes in operating procedures, especially in 1994, the series are not homogeneous.

Source: National data.

The table indicates that in practically all countries currency tends to absorb liquidity, as it increases over time. This is in fact the key item behind the persistent net autonomous deficits identified in the previous analysis in Australia, Italy, Spain and the United States. In contrast, the qualitative impact of the other items typically varies considerably both across countries and over time. As regards the monthly variability of the autonomous sources of bank reserves, the evidence suggests that net lending to the government is the most volatile component in a majority of cases. Its standard deviation is especially high in France, the United Kingdom and, to a lesser extent, the Netherlands and Spain. The influence of net foreign assets is comparatively high in some of the economies with strong exchange rate commitments, including several ERM participants. Currency rivals net lending to the government as the most volatile item in the United States and Japan.

Central bank influences

It is for measuring the comparative quantitative significance of policy instruments that the shortcomings of available data are most acute. The main reason is that the maturity of some of the most actively used operations, such as repos, generally falls well short of one month (see Section 4): operations of an opposite sign cancel out and the need to renew the transactions cannot be captured. Using averages of outstanding stocks during a (calendar) month would alleviate some of these problems, but was possible on a consistent basis only in a few cases. Using the standard deviation of flows at a monthly frequency, as in the previous analysis, can only tackle offsetting changes between months. Thus, unless the maturity of the operations is similar, the data below are more indicative of the extent to which instruments are used to offset changes in liquidity over longer-term horizons than of their deployment in daily liquidity management.

Table A.I.3

Breakdown of the net policy position: standing facilities and discretionary (market) operations[1]

	Standing facilities		**Discretionary operations**		***Memo: Standard deviation[2]***	
	1992-93	1994-95	1992-93	1994-95	*Standing facilities*	*Discretionary operations*
	as a percentage of the average level of currency and bank reserves					
Australia	2.49	3.81	2.62	4.56	*9.0*	*5.3*
Austria	- 0.43	- 0.38	0.00	0.03	*3.1*	*0.1*
Belgium	- 0.08	- 0.05	0.70	- 0.10	*1.9*	*4.2*
Canada	-	-	0.06	1.42	-	*3.4*
France	..[3]	..[3]	3.30	- 4.05	..	*30.1*
Germany	- 0.27	0.04	0.13	- 0.33	*0.8*	*4.2*
Italy	- 0.13[4]	0.11[4]	1.17	- 0.08	*2.2*[4]	*6.5*
Japan	0.00[5]	- 0.01[5]	- 0.71	1.18	*0.1*[5]	*7.5*
Netherlands	- 0.03	- 0.04	- 0.06	- 1.16	*0.9*	*2.3*
Spain	-	-	3.17	0.15	-	*9.8*
Sweden	..	..	- 7.86[6]	- 3.38[6]	..	*46.2*[6]
Switzerland	- 0.09	0.00	0.65	- 0.57	*0.6*	*4.8*
United Kingdom	0.07	- 0.06	2.70	- 4.02	*1.4*	*14.4*
United States	0.00	0.00	0.75	0.46	*0.0*	*1.0*

[1] Average monthly changes. See Box 2 for a definition of the terms and Section 4 for the transactions included. [2] For the period 1992-95. [3] Not available but very small. [4] Distorted by highly erratic end-of-year movements. [5] Fully discretionary discount window lending. [6] Including the use of standing facilities (frequent but very small since at least 1995). Owing to changes in operating procedures, especially in 1994, the series are not homogeneous.

Source: National data.

Despite these shortcomings, the available statistics do generally confirm central banks' greater and increasing reliance on discretionary, largely market, operations in comparison with standing facilities (Table A.I.3).[6] As measured by the standard deviation in monthly flows, the quantitative significance of market operations is almost universally considerably higher than that of standing facilities. The only exceptions are Austria and Australia. In the case of Australia this results from classifying the zero-cost central bank float associated with the ability of certain participants to choose the settlement date (T or T+1) as a (below-market) implicit standing facility; in that of Austria, it reflects the practice that has slowly been changing since the introduction of regular tenders in late 1995. A significant use of standing facilities is also noticeable in the Netherlands and Belgium.[7] Since by far the quantitatively more important facilities are for injecting liquidity, the cumulative net withdrawal of liquidity discernible in several countries since 1992 is at least in part a reflection of steps to reduce their structural significance, including through cuts in available quotas. This is confirmed by the breakdown of standing facilities by type, which highlights the net repayment of credit granted at below market rates (Table A.I.4).[8] The same table reveals the great reluctance of banks in the United States to turn to the discount window.

Table A.I.4
Breakdown of the net policy position: standing facilities[1]

	Market ceiling		**Market floor**		**Below market**		*Memo: Standard deviation*[2]		
							Market ceiling	*Market floor*	*Below market*
	1992-93	1994-95	1992-93	1994-95	1992-93	1994-95	1992-95		
	as a percentage of the average level of currency and bank reserves								
Australia	0.24	0.02	-	-	2.25	3.79	*0.4*	-	*9.1*
Austria	0.00	0.00	0.00	0.00	- 0.18	- 0.05	*0.0*	*0.9*	*0.4*
Belgium	0.00	- 0.01	- 0.02	- 0.02	- 0.06	- 0.02	*1.6*	*0.6*	*0.2*
France	..[3]	..[3]	-	-	-	-	..[3]	-	-
Germany	0.00	0.00	-	-	- 0.27	0.05	*0.3*	-	*0.8*
Italy	- 0.13[4]	0.10[4]	-	-	0.00	0.01	*2.2*[4]	-	*0.1*
Japan	-	-	-	-	0.00[5]	- 0.01[5]	-	-	*0.1*[5]
Netherlands	-	-	-	-	- 0.03	- 0.04	-	-	*0.9*
Spain	-	-	-	-	-	-	-	-	-
Sweden	..	..[6]	..	..[6]	-	-	..[6]	..[6]	-
Switzerland	- 0.01	0.00	-	-	- 0.07	0.00	*0.6*	-	*0.1*
United Kingdom	0.07	- 0.06	-	-	-	-	*1.4*	-	-
United States ...	-	-	-	-	0.00	0.00	-	-	*0.0*

[1] Average monthly changes. For the facilities included, see corresponding tables in Section 4. [2] For the period 1992-95. [3] Not available but very small. [4] Distorted by highly erratic end-of-year movements. [5] Fully discretionary. [6] Frequent but quantitatively very limited use of standing facilities since at least 1995.

Source: National data.

The classification of market operations by type tends to confirm the key role played by reversed transactions against domestic-currency-denominated assets, even when measured at the monthly frequency through changes in outstanding stocks (Table A.I.5). This is best shown by the comparatively high standard deviation of monthly changes in relation to those of outright transactions

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6 For present purposes, the analysis follows the classification given in Section 4. Standing facilities, therefore, include certain operations where a considerable degree of discretion is actually retained.

7 The figures for Italy are not representative of average behaviour.

8 In order to display the figures on a comparable basis, actual credit through the discount facility in Germany is reported, not the (discretionary) change in discount quotas. These were reduced throughout the period shown.

in securities and of other operations. The main exception not arising from shortcomings in the available data is Switzerland, where foreign exchange swaps are the principal instrument.

Table A.I.5

Breakdown of the net policy position: discretionary (market) operations[1]

	Outright transactions in securities		**Repo transactions against domestic currency**		**Other transactions[2]**		***Memo: Standard deviation[2]***		
	1992-93	1994-95	1992-93	1994-95	1992-93	1994-95	*Outright trans-actions in securities*	*Repo trans-actions against domestic currency*	*Other trans-actions[2]*
	as a percentage of the average level of currency and bank reserves								
Australia	2.42	4.27	0.20	0.29	-	-	*3.8*	*5.3*	-
Austria	-	-	- 0.25	- 0.30	0.00	0.00	-	*2.7*	*0.9*
Belgium	0.14	- 0.08	0.57	0.01	- 0.01[4]	- 0.02[4]	*1.1*	*3.7*	*0.8*
Canada	..	..	0.00	0.00	0.06	1.42	..	*2.8*	*4.3*
France	- 0.25	- 0.10	3.55	- 3.95	0.00	0.00	*1.9*	*30.3*	*0.0*
Germany	- 0.35	0.33	0.45	- 0.61	0.03	- 0.05	*1.2*	*4.2*	*1.2*
Italy	..	..	0.46	- 0.26	0.70	0.17	..	*6.2*	*1.6*
Japan	0.26	0.66	- 0.51	0.88	0.00	0.00	*4.0*	*5.8*	*2.7*
Netherlands	-	-	- 0.06	0.02	0.00	- 1.18	-	*2.0*	*1.1*
Spain	-	-	3.13	0.06	-	-	-	*9.8*	-
Switzerland	-	-	0.13	0.02	0.52	- 0.59	-	*1.8*	*4.2*
United Kingdom	0.80	- 1.51	0.83	- 0.02	1.07	- 2.49	*9.6*	*5.6*	*5.3*
United States ...	0.76	0.44	- 0.01	0.02	-	-	*0.7*	*0.5*	-

[1] Average monthly changes. See Box 2 and the corresponding tables in Section 4 for the transactions included. Transfers of government deposits are not excluded, although they are not normally considered to be "market" operations. Sweden is excluded owing to major breaks in the series. [2] Including, inter alia, FX swaps, issues of central bank paper (or of government paper on its behalf), transactions in the interbank market and transfers of government deposits. [3] For the period 1992-95. [4] Excluding foreign exchange swaps, for which no data are available.

Source: National data.

The fact that in a number of countries the average monthly flows connected with outright transactions are close to, if not higher than, those associated with repos is mainly a reflection of their longer maturity and their specific use, viz. as instruments typically designed to meet "longer-term" liquidity needs rather than to offset short-term fluctuations in those needs. This is most obviously the case in the United States, where the actual contribution of repos to changes in liquidity is very low, but it applies more generally. Detailed statistics on the daily impact on liquidity by type in Australia provide a vivid illustration of the extent to which the measurement technique employed can underestimate the extent to which short-maturity instruments are used to adjust the volume of bank reserves. Measured in terms of the gross amount of the operations, but without taking into consideration the maturity leg of the transactions, repos would account for over 90% of changes in liquidity, the remainder being associated with outright purchases/sales of Treasury notes. This figure is much higher than would be assumed on the basis of average monthly flows or their standard deviation (see the table).

Annex II: Reserve requirements: additional information

Box 4

Institutions subject to reserve requirements[1]

Australia:	Banks and industry organisations representing building societies and credit unions (known as "Special Service Providers").
Austria:	Generally, all domestic credit institutions.
France:	All credit institutions except the Caisse Française de Développement. Also exception for very small-sized institutions.
Germany:	With few exceptions, all institutions doing banking business (broadly defined).[2]
Italy:	All credit institutions except very small ones.
Japan:	City banks, regional banks, regional banks II, trust banks, long-term credit banks, branches of foreign banks, shinkin banks and Norinchukin Bank.
Netherlands:	All credit institutions with very few exceptions.[3]
Spain:	All credit institutions.
Switzerland:	All banks.
United Kingdom:	All authorised banks except very small ones.
United States:	Commercial and savings banks, credit unions, foreign bank branches and agencies, Edge Act corporations.

1 In Canada, the requirement to maintain a non-negative settlement balance with the central bank on average during monthly periods applies to direct clearers only.

2 See Section 1(1) and Section 53(1) of the Banking Act.

3 All institutions must be entered in the register under Section 52 of the Act on Supervision of the Credit System. There are four exceptions because their liabilities are almost exclusively long-term.

Table A.II.1
Reserve requirements: eligible liabilities and ratios

	AU	AT	FR	DE	IT	JP	NL[1]	ES	CH	UK	US
Non-residents											
• domestic currency	*			*	*	0.15	*	*	*	*	*
• foreign currency	*			*		0.15	*	*		*	
- netting				*						*	
• banks	*			*		0.15	*		*	*	
- only affiliated					*[2]						
- netting				*[3]						*[3]	
Residents					*						
• foreign currency	*		*[4]	*	*	0.2-0.25	*		*		
• banks	*	[5]	[5]	[5]		0-1.8	*		*	*	
- netting										*	
Type (ratios in %)											
• transaction & sight	1.0	5.0	1.0	2.0[6]	15.0	0-1.3[7]	variable	2.0	2.5	*	0.0-10.0[7]
• time/savings	1.0	3.0	0.5/1.0[8]	2.0/1.5	15.0	0-1.2[7]	variable	2.0	2.5[9]	*	
• certificates of deposit	1.0	3.0	0.5	2.0	15.0	0-1.8[7]	variable	2.0		*	
• repos	1.0		0.5	2.0			variable		*	*	
• other	1.0	3.0[10]	0.5[11]			0.1-0.15	variable	2.0[12]		*[13]	
Other restrictions											
• maturity		*[10]	<2y	<4y	<18m		[13]	*	*[14]		
• volume						*[7]					*[7]
• other	*		*[8]	*[15]			*[13]		*[9]	*	
Basis calculation											
• level		*	*	*		*	*	*	*	*	*
• change	*				*						

[1] The same criteria apply to the definition of eligible liabilities for the quota scheme. [2] Deposits by branches of Italian banks with the parent, in order to avoid circumvention. [3] As part of the netting of foreign currency positions. [4] In principle included, but subject to a zero reserve ratio. [5] Exempt as are other institutions subject to reserve requirements. [6] Sight deposits defined as less than one-month maturity. [7] The ratio varies with the size of the corresponding liability category. [8] Passbook accounts. Various types of savings deposit are exempt. [9] Only 20% of various forms of savings deposit. [10] Bank-issued domestic-currency-denominated securities with less than a two-year maturity (zero rate on longer maturities). [11] Off-balance-sheet liabilities. [12] Some off-balance-sheet items, including guarantees backing commercial paper and endorsed bills. [13] Most domestic-currency-denominated liabilities plus any foreign currency liability. The overall base is defined as domestic short-term liabilities plus 25% of all other liabilities. Variable ratios depending on the size of eligible liabilities and changing over time. [14] Less than three-month maturity for time deposits and gross interbank liabilities. [15] Certain detailed exemptions.

Annex III: Standing facilities: additional information

Table A.III.1
Standing facilities: additional information

	Type	Name	Technical form	Counterparties		Underlying instrument/ collateral	
				Banks	Other	Public	Private
AU	MC	Rediscount facility	Rediscount	*	*[1]	*[2]	
	MF	Interest-bearing balances	Deposit	*		-	-
AT	MC[3]	Lombard[3]	Fixed-term loan	*[4]		*	*
	MF	REGOM	Deposit	*[4]		-	-
	BM	Discount facility	Rediscount	*[4]		[5]	*[5]
BE	MC	Ordinary/hors plafond advances	Fixed-term loan	*	[6]	*	
	MF	Deposit facility	Deposit	*	[6]	-	-
	BM	Discount facility	RP	*	[6]		*[7]
CA	MC	Advances	Fixed-term loan	*[8]	*[8]	*	
FR	MC	5 to 10-day repurchases	RP	*		*[9]	*[9]
DE	MC	Lombard	Fixed-term loan	*[10]		*	
	BM	Discount facility	Rediscount	*[10]		*[11]	*[11]
IT	MC	Fixed-term advances	Fixed-term loan	*		*[12]	*[12]
	BM	Discount facility[1]	Rediscount	*		*[12]	*[12]
JP	BM	Discount window	Rediscount/fixed-term loan	*[13]	*[13]	*	*[14]
NL	BM	Advances (quota scheme)	C/A advance	*		*	*[15]
SE	MC	Lending facility	Fixed-term loan	*	*[16]	*	*[17]
	MF	Deposit facility	Deposit	*	*[16]	-	-
CH	MC	Lombard	Fixed-term loan	*		*	*[18]
UK	MC(1)	Late lending[19]	Fixed-term loan		*[20]	*	*
	MC(2)	Clearing banks' facility	Outright purchase	*[21]		*[22]	
US	BM	Discount window	Rediscount/fixed-term loan	*		*	*

Key to symbols: MC = market ceiling; MF = market floor; BM = below market.

[1] Any registered holder of Treasury notes. [2] Treasury notes. [3] For GOMEX, identical counterparties and collateral. [4] All domestic banks subject to reserve requirements. [5] Bills of exchange (promissory notes resulting from merchandise transactions) in local currency and issued by domestic firms, at least two signatures; possible for public firms if managed separately from the public administration. [6] In principle, certain institutions participating in the securities settlement system are also eligible. [7] Bills of exchange. [8] See Table A.IV.1 on the standing facility available to investment dealer-jobbers (PRAs) that takes the form of reversed transactions against government securities. [9] Treasury bills or grade 3 rated bills. [10] All credit institutions that maintain an account at the central bank (lombard) and doing bills business (rediscount facility, which excludes mortgage banks). [11] Bills of exchange, backed by three solvent parties; including issues by the federal government, one of the federal special funds or a Land Government. [12] Bank bonds as long as quoted and widely traded (in practice, never used so far). [13] Financial institutions with an account at the central bank, including some securities firms and money market dealers. [14] High-quality bills of exchange and bonds. [15] Very broad range, same as for special advances (see Table 4.6). [16] All institutions with an account at the central bank. [17] Mortgage bonds. [18] Marketable bonds and gold. [19] Including "2.45 lending" and "late-late lending". [20] Discount houses and gilt-edged market makers (2.45 lending) and discount houses only (late-late lending). [21] Clearing banks only. [22] Treasury bills.

Annex IV: Discretionary operations: additional information

Table A.IV.1
Discretionary operations: counterparties

	Operation(s)			Eligible institutions		Special status/ restrictions			Approx. actual No.
	Main/ key-note	**Other**	**Name/type**	**Banks**	**Non-banks**	**Primary dealers**	**Other**	**Special credit line**	
AU	*		RT, OT	*	*		*[1]		20[2]
		*	FXS	*	*		*[1]		20
AT	*		Weekly tender/RP	*[3]					30[3]
		*	FXS	*					10
BE	*		Weekly tender/RP, CL	*[4]					70
		*	I, RP, OT	*		*		*[5]	15
		*	FXS	*			*[6]		25
CA	*		TGD	*	*		*[7]		12[7]
		*	SPRA/RRP	*	*	*[8]		*[9]	10[8]
		*	SRA/RP	*			*[10]		6[10]
FR	*		Twice-weekly tender/RP, CL	*[11]		11			150[11]
		*	RT, I, OT	*[12]					<26[12]
DE	*		Weekly tender/RP	*[13]					400-600
		*	Quick tender/RP	*			*[14]		..
		*[15]	FXS	*			*[6]		..
IT	*		RP	*[16]	*[16]	16			50
	*		FXS	*	*		*[6]		35
		*[17]	Treasury bills/OT			*[17]			15
JP	*	*	Bills[18]/RP, RRP		*[19]		*[19]		6
	*	*	Treasury bills/RP	*[20]	*[20]		*[20]		59
		*	CPs/RP	*[21]	*[21]		*[21]		47
		*	Government bonds/RP	*[22]	*[22]		*[22]		53
		*	Government bonds/OT	*[23]	*[23]		*[23]		61
NL	*		Regular tender/CL	*[24]					12-25
		*	Central bank paper/S	*[25]					8-12
		*	I	*			*[26]		1-3
		*	FXS	*			*[6]		1-3
ES	*		Regular tender/RP	*[27]					100-150
		*	RT	*			*[28]		13
SE	*	*	Weekly tender & other/RP, I	*	*	*			11[29]
CH	*	*	FXS, RT, TGD	*[30]					15[30]
UK	*		Eligible bills/OT[31]		*[32]		*[32]	*[33]	7
		*	Gilts repo/RP	*[34]	*[34]			35	20
		*	Treasury bill tender/S	*[36]	*[36]				15
		*	Treasury bill sales/S	*[37]	*[37]		*[37]		22
US	*	*	RT, OT		*	*[38]			50

Footnotes to Table A.IV.1

[1] In principle, any member of the Reserve Bank Information and Transfer System (RITS). [2] A roughly equal number of banks and non-banks, out of a total of 136 eligible counterparties (53 banks and 83 non-banks). [3] In principle, all domestic credit institutions under the Austrian Banking Act which are subject to reserve requirements (de facto the number is limited to 60 since only the head institutions of sectoral banks are admitted). [4] All credit institutions established in the BLEU with a credit line with the central bank. [5] Within a quota, special credit/deposit facility at the central rate. [6] Domestically located institutions active in the foreign exchange swap market. [7] Direct clearers (8 banks, 4 non-banks). [8] Jobbers, i.e. core group of primary distributors making the market for government securities (5 dealers and 3 banks); until mid-1995, also main counterparties for outright sales of Treasury bills. [9] Purchase and Resale Agreements (PRAs) for the five investment dealer-jobbers, at Bank rate. [10] Six major banks. [11] All banks established in France can participate, but the bids are transmitted via the 26 principal market operators (OPMs). [12] In practice, with most active banks. [13] All credit institutions subject to reserve requirements. [14] Active money market participants. [15] In addition, any bank may act as counterparty in the sale of liquidity paper used to set a floor to market rates, when necessary. [16] All banks and primary dealers (specialists) in the screen-based market for Treasury bonds (MTS). [17] MTS primary dealers. In addition, the central bank carries out occasional bilateral reversed and outright transactions in Treasury bonds to ensure a smooth functioning of the market or limit bond price fluctuations (mostly with primary dealers). The corresponding impact on liquidity is sterilised. [18] Purchase of bills issued by financial institutions and sales of central bank and financing bills. [19] Money market ("Tanshi") dealers. [20] Money market dealers (6), banks (26) and securities firms (27). [21] Money-market dealers (6), banks (26) and security firms (15). [22] Banks (26) and securities firms (27). [23] Banks (25) and securities firms (36). [24] All credit institutions established in the Netherlands and participating in the quota scheme. [25] Same counterparties as for regular tenders plus foreign central banks. [26] Covert intervention, the central bank selects one of the major banks in turn. [27] All credit institutions subject to reserve requirements. [28] Group of "market makers" in government bond market selected by the central bank on the basis of their level of activity in both government bond and interbank deposit markets. [29] Including seven banks (one located abroad) and four non-banks, all members of the settlement system; fine-tuning deposit transactions (I) through which the central bank injects liquidity are carried out only with Swedish banks (7). [30] In principle, all domestically located banks; in practice, about 15 with the bulk of the operations being done with the three largest. [31] Including bill/floating rate gilts repos. [32] Discount houses, institutions subject to several obligations: expected to offer callable deposit facilities to banks and non-banks, making markets in bills, participating actively in the central bank's money market operations and underwriting the weekly Treasury bill tender. [33] "2.45" and "late-late lending". [34] All domestically located banks, building societies and gilt-edged market makers (GEMMs). [35] "2.45 lending" for GEMMs. [36] No restrictions; anyone can bid. [37] Discount houses (7) and clearing banks (15). [38] Subject, in particular, to the requirement of participating in the central bank's auctions.

Annex V: Resisting exchange rate pressures

It is at times when exchange rate commitments come under severe pressure that monetary policy operating procedures face the toughest test. On these occasions both liquidity management and signalling can be stretched to the full. The ERM turbulence in 1992, for instance, left a profound mark on techniques of policy implementation in Europe. By revealing potential, hitherto largely unsuspected limitations in existing arrangements, the crisis led to temporary as well as permanent changes in the range of instruments, the maturity and frequency of operations and rate-setting mechanisms.

This annex looks at the problems that periods of strong exchange rate pressure can pose for operating procedures and at ways in which they have been tackled. Liquidity management and interest rate setting aspects are considered in turn. As an illustration, much of the analysis draws on events during the exchange market turbulence in the summer-autumn of 1992 in the ERM and in Canada.

Liquidity management

When exchange rate pressures are resisted through intervention, the task of liquidity management is to allow the central bank to set interest rates without being constrained by the "autonomous" creation of bank reserves through the foreign channel, as net holdings of foreign assets are run down or accumulated. In other words, it is to permit the central bank to decide as freely as possible the pace and extent, if any, of changes in the interest rates under its control or close influence. This essentially means setting reserve balances at the level deemed appropriate for monetary policy purposes, by effectively "sterilising" the excess/shortage of liquidity induced by the foreign channel.[9]

The net creation of liquidity through the foreign channel can be huge, amounting in some cases to large fractions of the outstanding stock of policy instruments. These flows, as the unprecedented ones recorded during the ERM turbulence, can put the central bank's sterilising capability under serious strain (Graph A.V.1). Since the implications of sterilisation are quite different depending on whether intervention injects or withdraws liquidity, it is best to consider each of these two cases separately.

In countries where exchange rates come under upward pressure, central bank purchases of foreign for domestic currency will tend to increase domestic liquidity.[10] The main risk is that the central bank may not have sufficient ammunition to withdraw it, in which case market rates could fall to zero. Several factors can restrict the operational freedom of the central bank: legal prohibition to pay interest on its deposits or ceilings on the maximum amount of paper that can be sold on its own behalf or on behalf of the government (e.g. Germany), the limited marketability of foreign exchange claims for use in swap operations, the absence of reserve requirements (e.g. Belgium) or of liquidity-absorbing reversed sales against domestic currency claims (e.g. Germany and the Netherlands). While such instruments can be added to the armoury of weapons, it is often difficult to do so at short notice.

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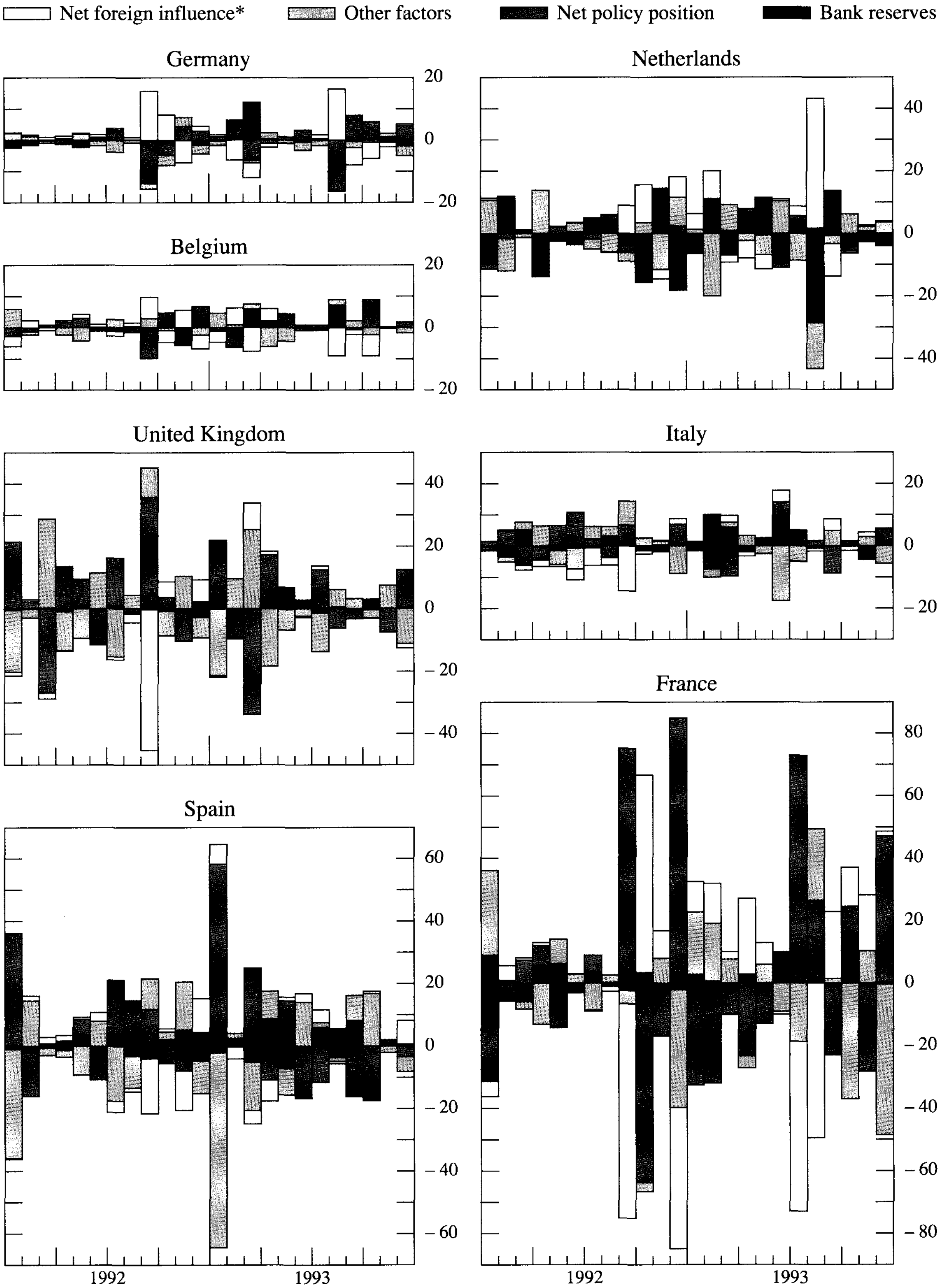
9 Of course, the central bank is interested only in the overall creation of bank reserves, not in the individual components. In that sense, it may be misleading to say that individual components are sterilised.

10 When foreign central banks intervene, the effect is similar unless they finance the intervention with official reserve balances held in the markets, in which case there is no direct impact on the balance sheet of the central bank in the country of issue. Part of the intervention at the time of the ERM turbulence was implemented this way.

Graph A.V.1

Liquidity management during the 1992 ERM turbulence

Changes, as a percentage of cash and reserves



* For Belgium, including foreign exchange swaps used to adjust domestic liquidity.

In the event, the countries facing liquidity surpluses in 1992 managed to absorb them through a continuing reliance on existing instruments, the reactivation of unused ones and the introduction of new instruments. In Germany, where the size of the central bank's balance sheet made the challenge more manageable, the authorities allowed outstanding repos to mature, cut the size of new allocations at tenders, activated reversed transactions against foreign currency and began to issue Treasury ("liquidity") paper, in the form of a very short-term (three-day) quasi-standing facility. In Belgium the central bank relied on a large scale on foreign exchange swaps, which had hardly been used until then: in this case, intervention tended to generate its own liquidity-withdrawing ammunition.[11] In the Netherlands, the flexible reserve requirement mechanism was successfully put to the test. Events also left a mark on the maturity and frequency of operations. In an effort to increase the flexibility of liquidity management, notably the amount of maturing central bank credit at any given time, both the Bundesbank and the Netherlands Bank cut the maturity of their regular keynote operations. In addition, in order to limit the injection of liquidity, the Bundesbank omitted one tender and the National Bank of Belgium halved their frequency. Most of these changes have survived to the present day. None of the central banks in this group, however, has added reverse repos against domestic assets to the range of available instruments.

In countries where exchange rates come under downward pressure, central bank purchases of domestic for foreign currency lead to a withdrawal of liquidity.[12] The risk is that the authorities may not succeed in injecting sufficient funds to meet the minimum settlement balance needs of banks, effectively losing control of very short-term rates and disrupting the settlement process. At first sight this may appear implausible: the central bank should in principle be able to grant credit at will. A limitation, however, may be the availability of acceptable collateral and sufficiently deep secondary markets. In September 1992, for the first time in a number of continental European countries, including France, Italy and Spain, the amount or distribution of collateral in the system represented a constraint on policy.

The central banks' response was in some respects similar to that of their counterparts facing large inflows. Instruments were newly introduced or reactivated, such as foreign exchange swaps in Italy and repos against gilt-edged paper in the United Kingdom;[13] these instruments are now routinely employed. Specific steps were taken to overcome the constraints on the availability or distribution of domestic currency collateral, including the reactivation of a long-dormant credit line in Spain, an increase in the fraction of commercial bills accepted for repos in France and a broadening of the range of counterparties in the United Kingdom. In addition, the Bank of Spain brought forward a reduction in reserve requirements planned for the following year. The maturity of market operations was temporarily shortened in Italy, where it was comparatively long, in order to limit the potential overhang of liquidity. In the United Kingdom, the temporary gilt repo facility was initially for a maturity of only one week, so as to give the central bank better control over liquidity conditions. It was subsequently renewed at maturities of up to two months. This was done with a view to reducing any undue pressure on the eligible bill market.

Setting interest rates

Periods of extreme exchange rate pressure raise equally, if not more, serious challenges for interest rate policy (Graph A.V.2). Some of these are of a technical nature, viz. how to go about raising interest rates and making sure that signals are not misinterpreted. Others are more fundamental, viz., even assuming perfect control of interest rates, how best to react to the tide of adverse market sentiment.

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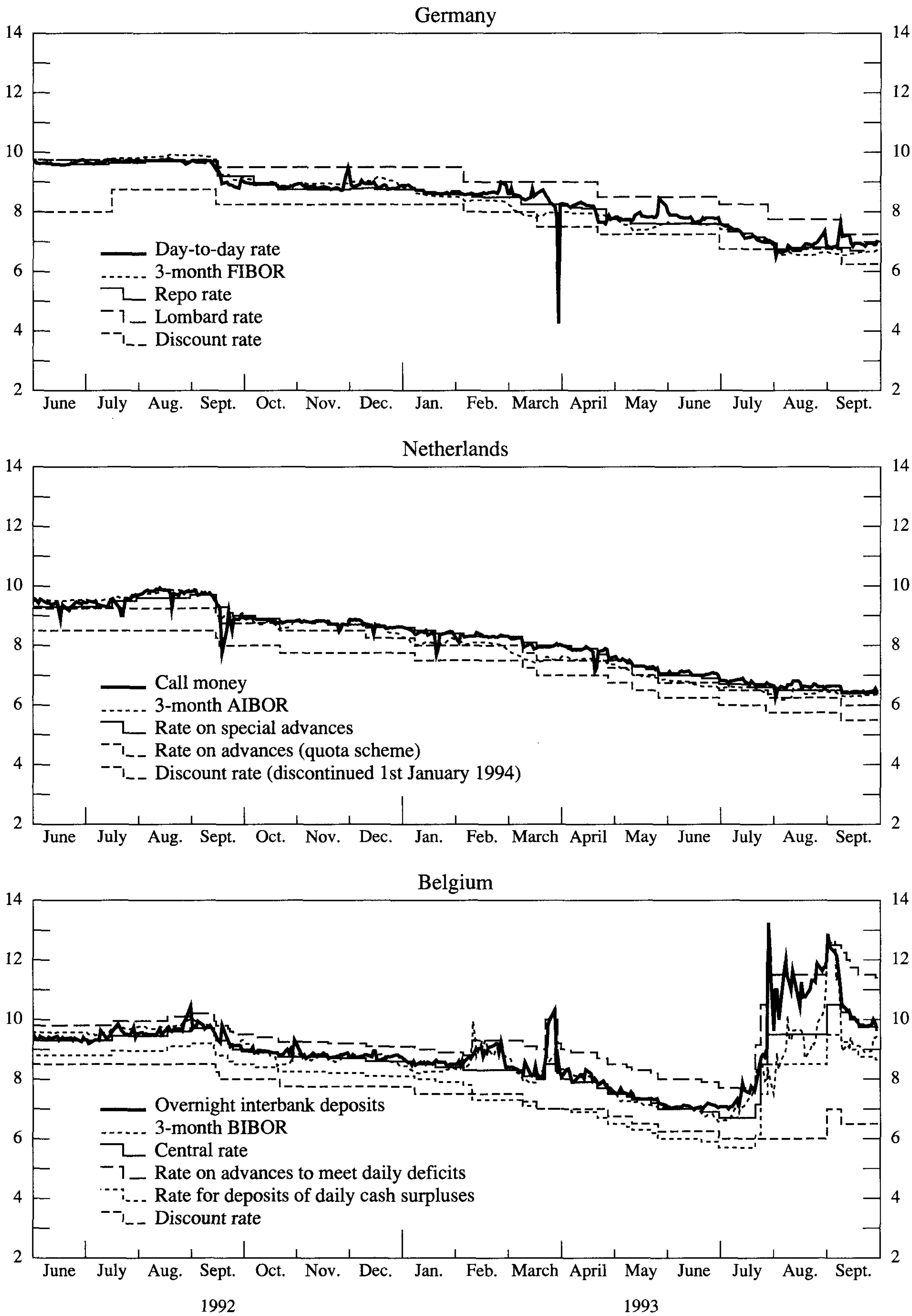
[11] In addition, the central bank cut the amount provided through the discount facility at below market rates.

[12] This withdrawal can be delayed by borrowing the necessary reserves or operating in the forward market, effectively sterilising the impact on domestic liquidity for the maturity of the operations.

[13] The gilt repo had not been used since 1988.

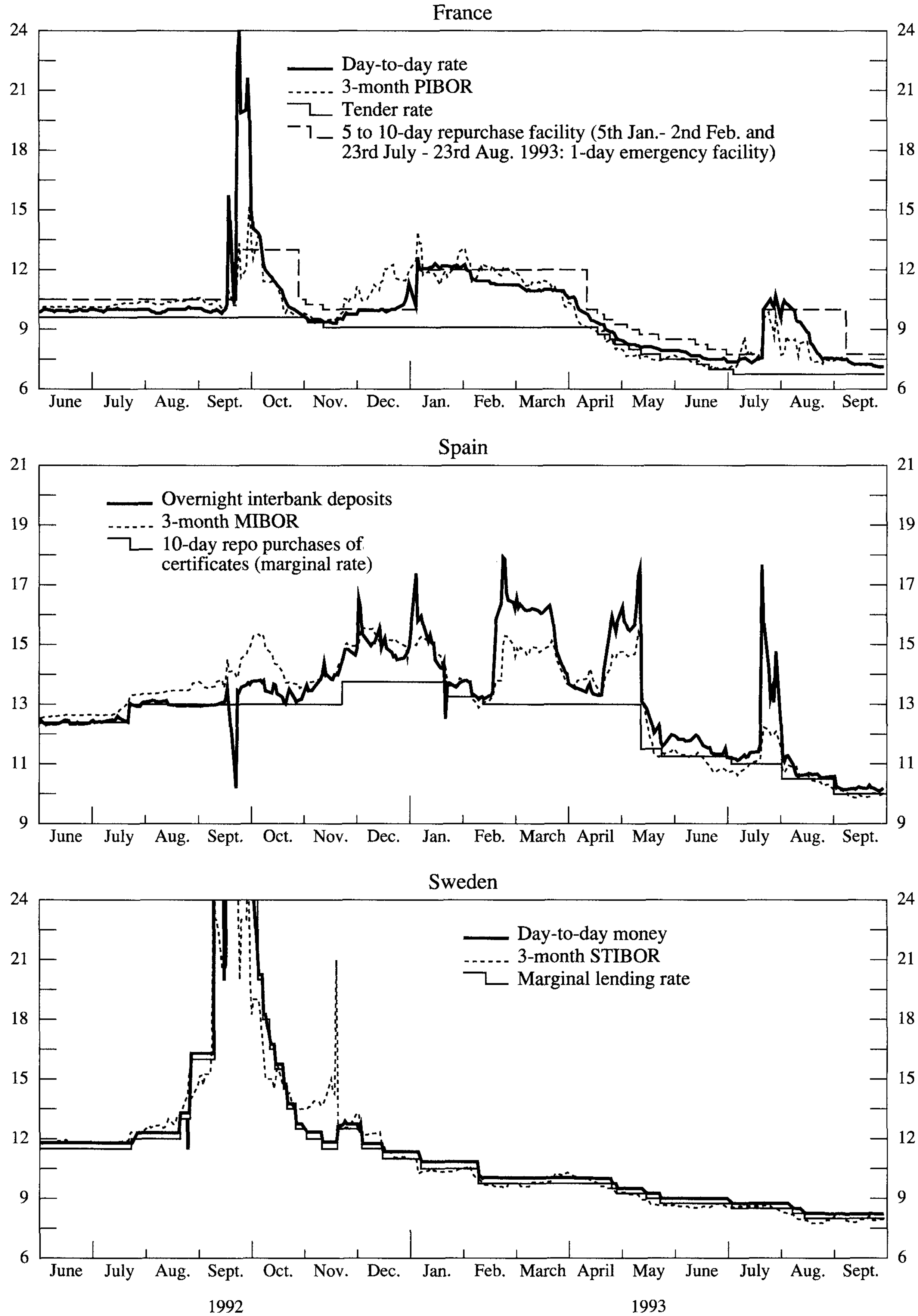
Graph A.V.2a

Interest rate setting at times of exchange rate pressure



Graph A.V.2b

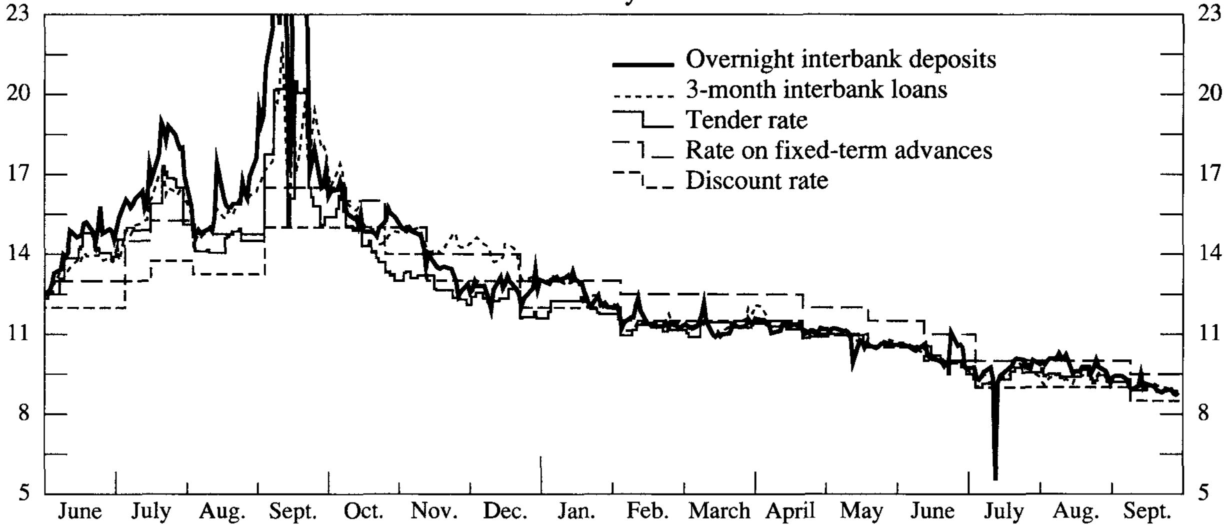
Interest rate setting at times of exchange rate pressure



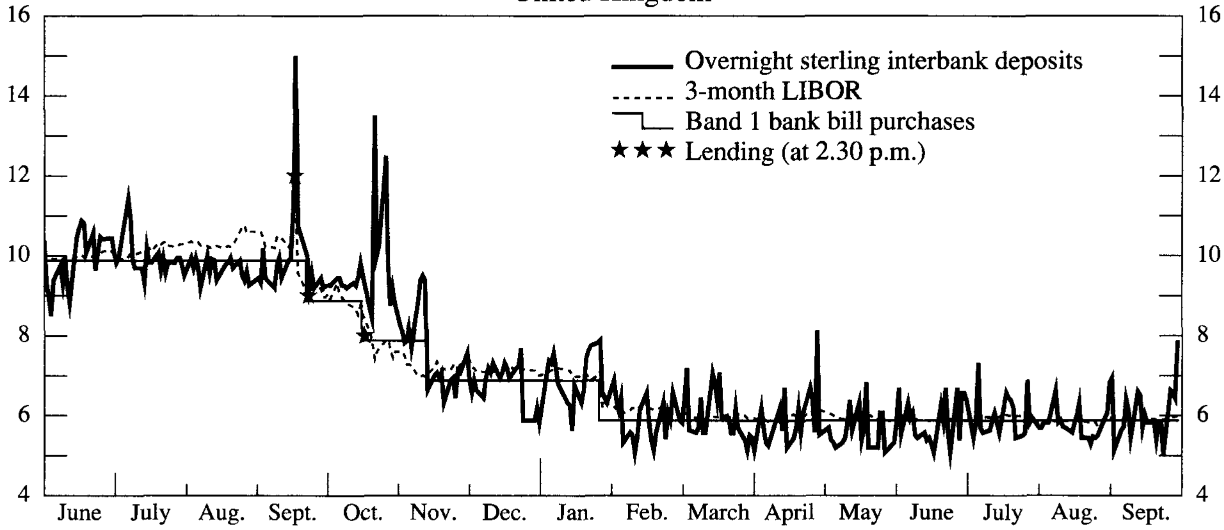
Graph A.V.2c

Interest rate setting at times of exchange rate pressure

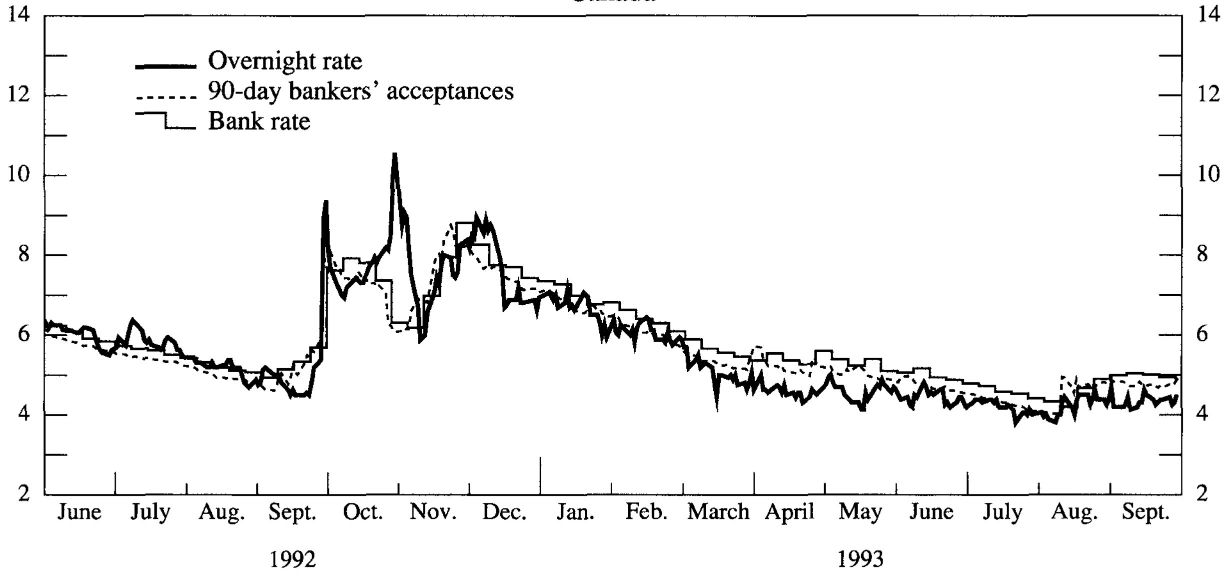
Italy



United Kingdom



Canada



The main problem when faced with unwarranted pressure on the exchange rate is how to demonstrate willingness to resist it while at the same time limiting the dislocation to the stance of monetary policy geared towards domestic objectives. Intervention per se merely buys time: unless exchange rates and/or interest rates are allowed to adjust, it hardly alters the potential gains from testing the exchange rate commitment. Moreover, in conjunction with the sterilisation of foreign flows, intervention supplies the necessary ammunition to sustain the tide of market sentiment: central banks provide participants with the strong currency and with the liquidity in the weak currency for short selling, on credit.[14]

For countries whose currency comes under upward pressure problems are comparatively manageable, at least in the core countries of de facto asymmetric exchange rate arrangements such as the ERM: arguably, the task there is mainly to stabilise the interest rate.[15] In Germany the shift to fixed rate repos supported by the liquidity paper quasi-standing facility was sufficient. For countries whose exchange rate is attacked the challenge is harder, since the costs of defending the currency are greater. A sustained rise at the very short end of the maturity spectrum risks propagation across the money market yield curve to those rates that play a more significant role in the transmission of policy impulses to the domestic economy, especially to the politically sensitive retail customers.

A typical tactic is to allow the overnight rate to drift up while maintaining or limiting the increase in keynote tender rates or in rates on standing facilities. In Italy in 1992 the central bank rationed credit through the fixed-term advances facility, which normally sets the ceiling to the overnight rate and influences more closely banks' base loan rates. In France the central bank did not alter the tender rates but induced banks to borrow a larger proportion of their funds from the five to ten-day facility at a higher rate; at the same time, the unequal distribution of scarce collateral helped to push the uncollateralised interbank call rate well beyond the rate on the standing facility. When the exchange rate came under more sustained pressure in the summer of 1993, the Bank of France instead suspended the 5 to 10-day facility and replaced it with overnight loans at discretionary interest rates in order to increase the uncertainty of the rollover refinancing costs of sales of domestic currency (settled on a T+2 basis). This tactic has been employed subsequently on occasions of exchange rate pressure. The Bank of Spain abandoned its practice of pre-announcing the weekly tender rate, introduced more frequent and flexible operations and encouraged the decoupling of the overnight rate from the keynote ten-day intervention rate. In addition, with a view to increasing selectively the cost of short selling, it imposed a temporary non-interest-bearing deposit on sales of pesetas by domestic banks to non-residents. The Bank of Sweden allowed the rate on its marginal overnight lending[16] to rise for a brief period to as much as 500% in September; in addition, for a while it supplied a small amount of credit to mortgage institutions at below money market rates.

Policies such as these can of course work for limited periods only. Their success partly depends on sound background economic conditions, which over time could defuse the market pressure, or on action to address underlying weaknesses, such as the announcement of fiscal restraint in Sweden. Their successful implementation also requires some form of market segmentation. In countries where neither of these conditions holds, resistance along these lines in not feasible.

Arguably, this was the case in the United Kingdom. In sharp contrast to France, for instance, most lending, even retail mortgages, is at variable rates and bank base rates respond almost instantly to changes in money market rates. Furthermore, at the time of the exchange rate pressure, the

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14 In the international markets, this is done largely through foreign exchange swaps: in effect, it is as if the agent selling the weak currency borrowed it by using the holdings of the strong currency as "collateral".

15 Problems may arise because of the impact on monetary aggregates, especially if targets are published. The reason is that while the central bank automatically sterilises the impact of exchange market intervention on bank reserves, it cannot as easily sterilise that on the money stock. The increase in resident holdings of short-term DM deposits led to a temporary increase in M3 in Germany. The issue of three to nine-month Treasury bill paper in early 1993 through a tender also open to non-banks was partly designed to absorb these holdings.

16 At the time, the central bank operated with a standing facility at an escalating rate.

economy was in a weak cyclical position and the household sector overburdened with debt. With one to three-month rates responding closely to changes in the keynote tender rate and no independent way of calibrating movements in the overnight rate, the Bank of England's room for manoeuvre was quite limited. Strong indications of resistance through actual increases in the keynote rate could simply have added further fuel to sales of sterling. Holding the rate steady while at the same time not giving the impression of reluctance to raise it as a last resort was an almost impossible task.

Similar but more subtle signalling problems were faced by the Bank of Canada when its exchange rate came under unwelcome heavy downward pressure in the autumn of 1992 against the background of heightened political uncertainty. Much as in the United Kingdom, and in an economy where variable rate credit is also quite widespread, the task was seen as that of limiting the rise in market rates for fear that this could be taken as a sign that the situation was precipitating. The signals, however, did not appear to work entirely as planned.

On 29th September, when money market rates were rising sharply, failure to provide assistance early in the day through repos (SPRAs, to limit increases in the overnight rate), followed by reverse repo operations later in the day as rates had eased back somewhat (SRAs, to limit declines), appeared to be interpreted not as ratification of the late-day lower rates, but as willingness to allow rates to rise: the lower bound was still higher than on the previous day while no clear upper bound had been signalled.[17] Coupled with continued volatility in the exchange rate, this appeared to generate expectations of further interest rate increases. The Bank of Canada responded by offering repos (SRPAs) the following day at the prevailing, somewhat higher, overnight rate, and by being aggressive through the cash setting, to signal willingness to see the rate decline. The response to the cash setting, however, was very muted and the overnight rate failed to decline. The noisy nature of the signal was heightened at the time by certain technical factors and by the market turbulence, which made it harder for banks to anticipate cash flows and disrupted traditional demand patterns for reserves. In the event, in order to unlock the situation, the following day the Bank of Canada took the unusual step of announcing in the morning that assistance would be available to dealers, if the need arose, at Bank rate. The clear signal worked, and the situation normalised without any assistance actually being provided.

[17] At the time, there was no explicit operating band, and SRAs and SPRAs signalled views about the overnight rate consistent with the operating objective for the three-month Treasury bill rate (effectively, Bank rate).

Annex VI: Real-time gross settlement

With the exception of the United States and Switzerland, where they have been in operation for quite some time, most countries covered in this study have either just introduced or are planning to introduce RTGS systems in the near future as the *main* mechanism for settling interbank transactions.[18] The move is part of a broader effort by central banks to manage more effectively the liquidity and credit risks in the settlement process, heightened in recent years by the spectacular growth in the volume and value of transactions associated with financial liberalisation and innovation. The shift, however, also has implications for the implementation of monetary policy. This annex considers these issues in more detail and somewhat speculatively.

In a discrete-time net settlement system, funds transfer orders are accumulated and finally settled only at the end of the day on a multilateral net basis. In an RTGS system, by contrast, funds transfers are settled at any time, as soon as the sending bank has sufficient funds available on its account with the central bank. The key implication is the need for *intraday* settlement balances and, generally, *intraday* credit, neither of which are required with discrete-time net settlement. The key issue is how this additional constraint on financing and hence on transaction possibilities can affect the implementation of monetary policy.

Following the outline of the paper, it is useful to distinguish two types of possible effect: those connected with the demand for bank reserves and those connected with their supply (central bank credit).

The demand for bank reserves under RTGS

The main question regarding the demand for bank reserves is how the need for intraday settlement balances may affect the characteristics of the demand for end-of-day holdings. The answer probably is that, in general, it would not imply substantial changes. Banks would clearly continue to attempt to minimise their end-of-day balances and these would remain insensitive to market rates. Where a pre-settlement lending/borrowing round restricted to settlement participants is allowed, the situation would not seem to be fundamentally different from that prevailing in net settlement systems: the information available to participants would be broadly similar and so would transaction possibilities.

On the other hand, the efficiency in the settlement process will very much depend on the detailed features of individual systems. Inevitably, settlement on a gross basis makes greater demands on interbank transactions. Unless sufficient central bank intraday credit is available and other liquidity management facilities (e.g. queuing) work smoothly, frictions in the redistribution of reserves could spill over onto end-of-day working balances, making them more unpredictable. Such frictions may be especially an issue in systems characterised by a comparatively large number of banks.[19] As a result, for any given degree of predictability in autonomous factors, an RTGS system could call for greater reliance on "calibrating", possibly late-day, central bank operations or on standing facilities.

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[18] The exception is Canada, where the new large-value interbank settlement system will settle on a net basis at the end of the day. A pre-settlement round is designed to allow banks to target approximately zero balances. The new system will imply changes in policy operating procedures. Averaging will be abolished. Official rates on end-of-day deficits and surpluses will be set at Bank rate and Bank rate minus 50 basis points respectively, thereby defining the limits of the operating band for the overnight rate. The Bank of Canada will then balance the market each day via its regular operations.

[19] Where there are few banks, information problems are manageable and quasi-netting parallel arrangements can be developed. However, the oligopolistic nature of the market could lead to other types of problems, such as attempts to "corner" the market.

The supply of bank reserves under RTGS

The central bank faces essentially two questions. First, what should be the terms on which it grants intraday credit, if any? Second, what should be the relationship between these terms and those applicable to end-of-day (interday) credit?

The question of terms applying to intraday credit has more to do with risk management and the proper functioning of markets than with monetary policy per se. Except in a few cases, especially where very few banks account for the bulk of all large-value transactions, the prevailing view is that specific liquidity management facilities have to be complemented with substantial intraday central bank credit in order to ensure that transactions can be carried out smoothly. Moreover, such credit is, or is planned to be, granted against collateral but otherwise at zero cost.[20] The only exception is the United States, where no collateral is normally required, but since 1994 a small fee is charged. As a result, there are few, if any, incentives for the emergence of an intraday money market.

From the viewpoint of central bank operations, these decisions regarding the terms on intraday credit raise two issues. The first concerns the mechanisms through which the credit should be provided. This can be done, as in the United States and as planned in several countries, through an overdraft facility, which would then be backed by sufficient collateral or equivalent legal protection. An alternative is to supply ample credit through intraday repos, the set-up arrangement adopted in the United Kingdom since the system was launched in April 1996.

The second issue concerns the potential impact of these systems on the use of collateral at times when liquidity management operations come under strain, as during severe pressure on exchange rates. As discussed in Annex V, the size of flows nowadays can be such that for countries experiencing outflows limits on the availability and efficient redistribution of collateral may be tested. If the amount "blocked" by the supply of intraday credit in the RTGS system is sizable, the central bank could face considerably greater difficulties in sterilising the withdrawal of liquidity. Vice versa, allocation of collateral for interday operations could reduce the available pool for intraday credit, potentially disrupting the normal functioning of markets. The fact that periods of market turbulence are also ones of high market activity and turnover heightens this risk. It is, however, too early to assess its quantitative significance.

As long as the central bank sets the terms on overnight financing separately from those on intraday credit, monetary conditions are not affected by the terms on which intraday finance is provided. A "quantity" spillover can nevertheless take place if amounts of intraday credit outstanding at the end of the day are automatically converted, albeit on different terms, into longer interday finance. This is formally little different from end-of-day credit granted by the central bank to help settlement in discrete-time net settlement systems, sometimes in the form of a standing facility. The question remains, however, whether in practice it may be harder to ration end-of day credit when deemed desirable. Again, this may be particularly important when exchange rate commitments are tested by the markets. In order to limit the risk of such "spillovers", requirements to repay intraday credit by the end of the day and penal terms on residual end-of-day financing can be introduced. Most countries have done so or are planning to.

But looking further ahead ...

The possibility for the central bank to set separately the terms on intraday and overnight credit relies on the fact that no sequence of intraday credits can substitute for an overnight contract. This is partly because, at present, no settlement system actually operates round the clock, so that "gaps" in "intraday credit" still exist. Moreover, while the foreign exchange market is already, in effect, a 24-hour market, frictions are such that settlement still generally takes place on a T+2 basis.

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20 Collateral, of course, has an opportunity cost.

Straining one's eyesight into the future, however, it is possible to conceive of a world in which these constraints will gradually disappear. At that point, the neat separation between intraday and overnight credit would no longer hold. Credit over different short, "intraday" horizons would have a specific value and arbitrage would create a well-defined term structure extending to intraday segments. The central bank's control over interest rates would, presumably, retreat further and shorter rates than the current overnight rate could become the fulcrum of policy. No doubt, we are a very long way from such a world. Yet it is difficult to believe that this is not the direction in which gradually, and perhaps inevitably, we are moving.

List of common symbols used in the tables

*	=	yes	AU	=	Australia
[blank]	=	no	AT	=	Austria
..	=	not available	BE	=	Belgium
-	=	not applicable, non-existent	CA	=	Canada
Δ	=	change (first difference)	FR	=	France
O/N	=	overnight (day-to-day)	DE	=	Germany
S-T	=	short-term	IT	=	Italy
d	=	day	JP	=	Japan
w	=	week	NL	=	Netherlands
m	=	month	ES	=	Spain
y	=	year	SE	=	Sweden
av.	=	on average	CH	=	Switzerland
CL	=	collateralised loan	UK	=	United Kingdom
FXS	=	foreign exchange swap (purchase or sale)	US	=	United States
I	=	operation in the interbank cash market			
OT	=	outright transaction, secondary market			
RP	=	reversed purchase (repo)			
RRP	=	reversed sale (reverse repo)			
RT	=	reversed transaction (repo or reverse repo)			
S	=	sale of (central bank) short-term deposits or short-term government paper			
T+i	=	the value date of the transaction is i days after the trade date (T)			
TGD	=	transfer of government deposits			
$\approx$	=	approximately equal to			
$\overline{R}^2$	=	adjusted R-squared			
SEE	=	standard error of the equation			
(.)	=	figures in brackets below coefficient estimates are standard errors			
*	=	statistically significant at the 10% level			
**	=	statistically significant at the 5% level			
***	=	statistically significant at the 1% level			