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INFLATION AND OUTPUT: A REVIEW OF THE WAGE-PRICE MECHANISM

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Introduction

Since the late 1970s a medium-term strategy has formed the basis for macroeconomic policies in most industrialised countries. This strategy has four components:

- a reduction in fiscal deficits and in the government share of output;
- a shift in the distribution of factor income in favour of profits;
- removal of rigidities in labour and product markets;
- relatively tight monetary policies to reduce and then stabilise inflation at a low rate.

A key assumption behind the medium-term strategy is that there is no long-run trade-off between inflation and the level of output. This assumption is also known as "the long-run neutrality of money" or the "natural rate hypothesis" (NRH). Thus expansionary monetary policies may temporarily increase output and lower unemployment, but the economy will eventually return to the natural rate of unemployment at a higher rate of inflation. Conversely, deflationary policies will over a certain period reduce output as well as the rate of inflation, but in the end only the reduction in inflation will remain as the economy again returns to its natural rate.

So far the medium-term strategy has been a success in many respects. Government deficits have been reduced and profit shares are in many countries back to pre-1973 levels. Moreover, the restrictive monetary policies adopted almost universally have contributed to the largest deceleration of inflation in the post-war period and have also helped to maintain inflation at a low and stable rate for the last two to three years. Yet in two respects the strategy has been disappointing. The fall in inflation was accompanied by very large output losses and the response of inflation to the policies adopted was subject to long lags. Secondly, in Europe and, to a lesser

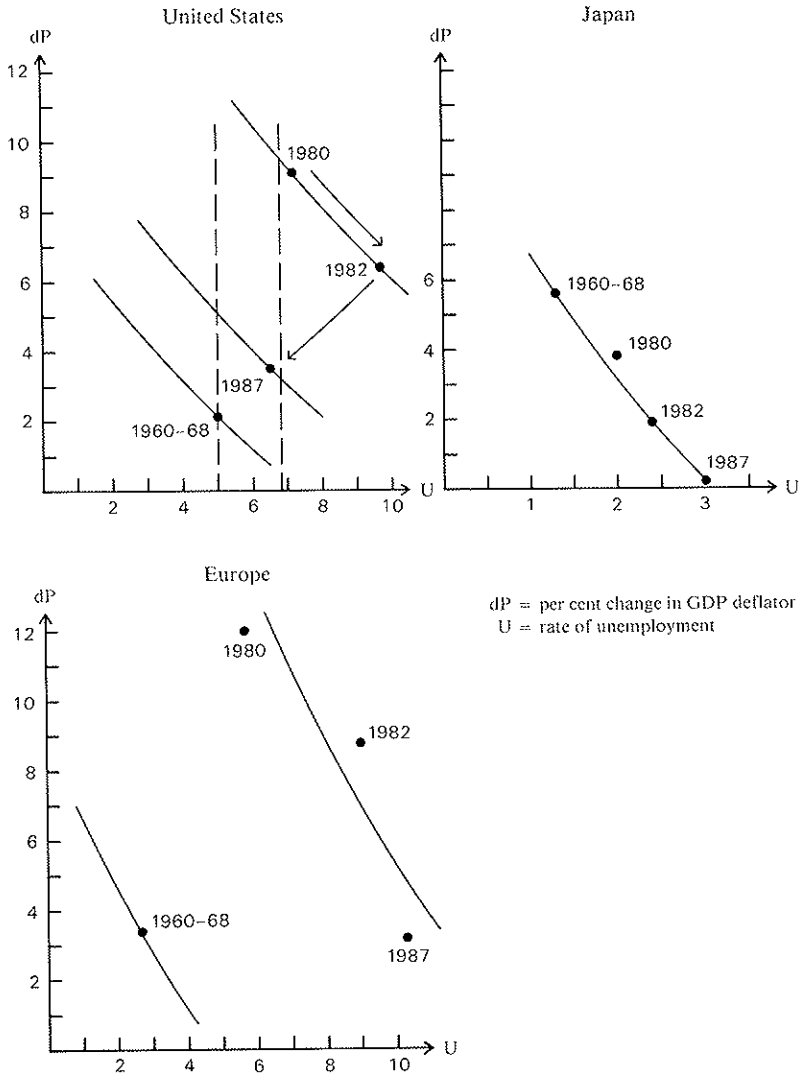
extent, Japan there have so far been no signs of a return to a natural rate of unemployment. As can be seen from Graph 1, the NRH seems to hold for the United States, as the policies adopted in 1979–80 initially reduced inflation as well as employment, but by 1987 the rate of unemployment had returned to its initial level and during 1988 it fell below what many previously considered to be the natural rate. However, in Europe and Japan it is difficult to find evidence of the NRH. Obviously, in both cases the rate of inflation has been substantially reduced, but the rate of unemployment has stabilised at a level which is considerably higher than in 1979–80.

When attempting to explain these disappointing aspects, it is natural to look to the wage-price mechanism in industrialised countries and this is the main topic of this paper. Following a brief review of short and long-run trends in output, inflation and money supply growth in Section I, Section II surveys major models of the wage-price mechanism. In particular, it discusses those theories which can explain why a change in monetary policy is not immediately reflected in a parallel change in the rate of inflation but is accompanied by real output effects, which may last for four to five years. Section III turns to the empirical evidence with respect to the parameters of the wage and price equations which are responsible for the persistent output effects of monetary policy changes, while Section IV surveys various hypotheses concerning the particular shape of the European Phillips curve. Finally, Section V deals with some unresolved issues and attempts to draw conclusions and policy implications.

In focusing on the wage-price mechanism, the paper leaves out a number of subjects which are also closely related to the problem of inflation. It does not discuss the longer-term aspects of an ongoing and steady rate of inflation, such as whether it is entirely neutral and whether the optimum rate is positive, zero or negative. Moreover, the paper has little to say on the causes and effects of inflation, and the formation of inflationary expectations is treated only superficially. The paper also neglects several international aspects of inflation, especially the role of exchange rate movements. Export and import

Graph 1

Inflation and Unemployment



dP = per cent change in GDP deflator
U = rate of unemployment

prices are mentioned as components of aggregate price equations and as possible sources of supply shocks, but the transmission of inflation between countries is mentioned only briefly and hypotheses regarding the "world rate of inflation", which were very popular some years ago, are not discussed. Finally, many technical aspects of the wage and price adjustment process have been left out in order not to overburden the text with equations and mathematical proofs. Readers interested in a more rigorous presentation and discussion of the various issues are referred to two recent surveys [Blanchard (1987b) and McCallum (1987a)] from which many aspects and ideas in the following text have been taken.

Because of these limitations, this paper is by no means a survey of inflation. It is rather an attempt to review certain aspects of the inflation process which are thought to be of interest to policy-makers concerned about the real and nominal effects of their actions and about the process by which policy changes are transmitted to the "real" economy.

I. Inflation and Output Developments

(a) Longer-run Trends. Average inflation rates for the period 1960–87 are shown in Table 1a together with average growth rates for real output and money supply for the G-10 countries plus Austria, Australia and Denmark.[1] The table also includes a measure of year-to-year variations and simple correlation coefficients, with the latter included as an expository device and not intended as a measure of causal relationships.

Italy and the United Kingdom are the two countries with the highest average inflation rate over the period, followed by Denmark

[1] The three countries were added to create a larger sample for cross-country calculations and comparisons. Southern Europe is under-represented in the sample, but for most of the period the countries of that region would have been "outliers" in terms of real growth as well as inflation and would have biased the cross-country computations.

Table 1a
Inflation, Real Output and Money Supply[1]

Countries	Average rates			Standard deviation			Correlation coefficients[2]			
	dP	dQ	dM	P_{sd}	Q_{sd}	M_{sd}	$R_{Y,M}$	$R_{Q,M}$	$R_{P,M}$	$R_{P,Q}$
	Based on year-to-year changes, 1960–87									
United States	5.1	3.1	9.5	2.7	2.4	2.8	0.39*	0.09	0.29	−0.51**
Japan	5.3	6.6	14.2	4.1	3.8	5.5	0.57**	0.51**	0.25	−0.07
Germany	4.1	3.1	8.9	1.7	2.3	2.6	0.43*	0.32	0.28	−0.02
France	7.1	3.8	12.5	3.3	2.1	4.2	0.51**	0.21	0.29	−0.56**
United Kingdom	8.2	2.4	12.5	6.1	2.1	8.0	0.21	0.06	0.20	−0.53**
Italy	10.2	3.8	16.3	6.1	2.6	4.8	0.61**	−0.18	0.62**	−0.52**
Canada	5.6	4.4	10.8	3.3	2.2	5.6	0.67**	−0.07	0.72**	−0.36
Australia	7.6	4.2	10.9	4.7	2.3	4.2	0.76**	−0.04	0.68**	−0.48**
Austria	4.9	3.5	11.4	1.7	2.0	3.0	0.57**	0.33	0.46*	−0.07
Belgium	5.1	3.3	9.0	2.7	2.3	3.0	0.47*	0.18	0.39*	−0.37
Denmark	7.8	3.0	11.1	2.3	2.6	4.3	0.20	0.09	0.18	−0.46*
Netherlands	5.4	3.5	9.5	3.0	2.8	5.7	0.53**	0.40*	0.42*	0.23
Sweden	7.2	2.8	9.2	3.0	2.0	3.9	0.13	−0.15	0.24	−0.63**
Switzerland	4.6	2.7	8.9	2.3	2.9	3.3	0.37*	0.52**	−0.10	−0.15

[1] Inflation (dP) is measured by changes in the GDP deflator, output (dQ) by changes in real GDP and money supply (dM) by changes in M_3 for the United States, Germany, the United Kingdom, Italy, Sweden and Switzerland and in M_2 for Japan, France, Canada, Australia, Austria, Belgium, Denmark and the Netherlands. [2] Significance levels indicated by * (5%) and ** (1%). dY is changes in nominal GDP and for small changes = dP + dQ.

and Australia, while the lowest rates of price increase are observed for Germany and Switzerland. Japan has the highest real output growth, followed by Australia and Canada, with the lowest rates being recorded for the United Kingdom, Sweden and Switzerland. Money supply growth has been highest in Italy and Japan and the lowest rates are found for Germany and Switzerland.[2]

Leaving the variability measure to be discussed below and turning to the last four columns of Table 1a, one feature is that the correlation between changes in nominal income and money supply is everywhere positive and in eleven cases significantly so. In five countries (Italy, Canada, Australia, Austria and Belgium) the significant correlation can be related to price changes and in two

[2] Average growth rates for money supply are probably influenced by the aggregate used. For all countries we chose the widest possible aggregate which was available for the whole period.

cases (Japan and Switzerland) to real output changes, while in the Netherlands both output and price changes provide a significant contribution. The last column shows a negative correlation (except for the Netherlands) between real output and price changes and in half the cases the correlation is significant. This is likely to reflect a cyclical phenomenon, as inflation tends to be low early in the cycle when output growth is strong, whereas later on output growth declines and inflation accelerates.

The correlation coefficients in Table 1a are based on separate time series for each country and tend to be dominated by cyclical developments. Table 1b shows similar correlations, but calculated across the fourteen countries using average values. This may give a better impression of longer-run relations and also makes it possible to include variability measures in the analysis. Probably the most striking feature of Table 1b is the high and positive correlation between the variability and the level of inflation. This confirms an "old" observation in empirical macroeconomics that the variability of inflation tends to rise with the average rate of inflation (or vice versa).[3] The variability of inflation is also positively correlated with the variability of money supply changes and with the average growth of money supply. A second feature of Table 1b is the high and positive correlation between average inflation and average money supply growth, which is now much more pronounced than in the separate country series and thus gives more support to the money neutrality hypothesis.[4]

By contrast, the variability of inflation or money growth (often taken as indicators of uncertainty) does not seem to be correlated with average output growth or the variability of output growth.[5] Instead, the variability of output growth is strongly correlated with

[3] See also Coe and Holtham (1983), who find a similar relationship for all OECD countries and review earlier studies of this issue.

[4] See also Mishkin (1984) who uses a sample of fifty-four countries and finds a correlation coefficient of 0.96.

[5] A similar result is reported in Duck (1988) for a sample of 33 countries.

Table 1b
Cross-country Correlation Coefficients

	dP	P_{sd}	dQ	Q_{sd}	dM	M_{sd}
dP	–					
P_{sd}	0.77**	–				
dQ	−0.07	0.19	–			
Q_{sd}	−0.19	0.09	0.65*	–		
dM	0.66**	0.69**	0.49*	0.29	–	
M_{sd}	0.47	0.72*	0.17	0.16	0.47	–

Note: Notation and statistical significance levels as shown in Table 1a.

average output growth, suggesting that countries "going for high growth" are more likely to encounter constraints and hence to be forced to rein in real growth through restrictive policies than countries pursuing a more stable growth policy. Finally, it is worth noting that when measured across countries the correlation between inflation and real growth is virtually zero.[6] This gives some support to the earlier observation that the negative correlation observed for individual countries was mainly a cyclical phenomenon and it may be seen as the net outcome of two long-run trends: on the one hand, in countries with relatively accommodating policies and operating close to capacity limits, high growth tends to be accompanied by high inflation; on the other hand, when money supply targets are rigorously enforced and velocity is stable, a high rate of inflation will "crowd out" real growth and produce a negative correlation.

(b) Features of the Recent Deceleration. Table 2 presents inflation rates for the 1980s for the same group of countries as shown in Table 1a. On average, the inflation rate fell by almost six percentage points and, because the deceleration was most pronounced in traditional high-inflation countries, the decline in the average rate was accompanied by a significant convergence of inflation rates

[6] This independence of price and output developments may also be observed in forecasts. For instance, when comparing the predictions of fifty US forecasters for 1989, the correlation between the rates of consumer price inflation and real GDP growth is negative but only 0.15.

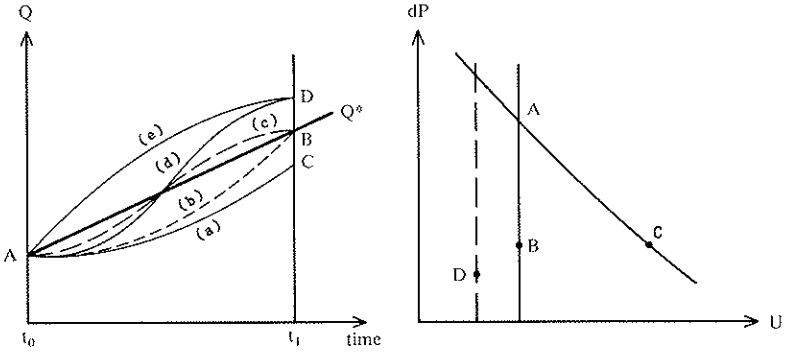
Table 2
Recent Inflation Trends

Countries	1980	1981	1982	1983	1984	1985	1986	1987	Deceler-ation peak trough	Change in rate of unem-ployment	Cumulative output loss 1980–87	
	percentage change in GDP deflator								percentage points		% GDP	(Trend GDP)
United States	9.0	9.6	6.5	3.8	3.8	3.0	2.6	3.3	7.0	−1.0	2.3	(2.8)
Japan	3.7	3.3	1.9	0.8	1.2	1.4	2.0	−0.2	3.9	0.8	2.7	(4.2)
Germany	4.8	4.0	4.4	3.2	2.0	2.2	3.0	2.1	2.7	5.0	6.5	(2.3)
France	12.3	11.7	12.7	9.5	7.2	5.8	4.1	2.5	10.2	4.2	2.6	(2.0)
United Kingdom	18.6	10.5	7.1	5.3	−5.4	5.8	2.7	4.4	16.0	4.6	4.3	(2.3)
Italy	20.6	18.5	16.2	14.9	11.4	8.9	7.5	5.6	15.0	4.8	4.5	(2.9)
Canada	10.6	10.8	8.7	5.0	3.1	2.9	2.5	4.3	8.3	1.5	0.4	(2.9)
Australia	10.1	10.8	7.7	8.0	6.6	5.8	7.4	7.7	5.0	2.1	0.6	(3.0)
Austria	5.1	6.3	6.2	3.7	4.9	3.0	4.0	2.5	3.8	3.8	2.4	(2.0)
Belgium	3.7	5.1	7.1	5.9	5.2	5.5	3.8	1.4	5.7	3.0	4.0	(2.0)
Denmark	8.2	10.1	10.6	7.6	5.7	5.3	4.2	5.0	6.4	1.1	1.9	(2.1)
Netherlands	5.6	5.5	6.3	1.8	1.8	1.7	0.9	−1.0	7.3	6.6	6.5	(2.0)
Sweden	11.7	9.5	8.7	9.7	7.7	6.7	7.2	5.2	6.5	0.0	1.5	(2.0)
Switzerland	2.7	6.9	7.3	3.3	2.8	2.7	3.8	2.5	4.8	0.6	2.6	(2.4)
Average	9.1	8.7	8.2	6.1	5.0	4.4	4.0	3.3	5.8	2.6	3.1	–
Standard deviation	5.6	3.9	3.6	3.9	2.8	2.2	1.9	2.4	3.7	–	–	–

across countries, with the standard deviation dropping from 5.6 in 1980 to a low of only 1.9 in 1986. While for obvious reasons the *potential* deceleration is larger in high than in low-inflation countries, the correlation between the *actual* deceleration and the previous peak is at +0.87 nevertheless surprisingly high. At the same time, the costs of reducing inflation, measured by either the rise in unemployment or the cumulative output loss, have not been appreciably larger in countries with large inflation gains than in traditionally low-inflation countries. For both measures the correlation with the decline in inflation is only about one-third. On the other hand, given the different views of the likely adjustment path following the adoption of anti-inflationary policies, this absence of a significant correlation between inflation and output should not be considered a major surprise.

(c) Alternative Adjustment Paths. Returning for a moment to 1980, one might attempt to simulate the likely outcomes of a

Graph 2



determined policy to reduce inflation and compare these to the predictions of various schools of thought at that time.[7] The hypothetical outcomes are shown in Graph 2,[8] where on the left-hand side real output is shown on the vertical axis, time on the horizontal axis and the line A-Q* is the potential output growth path. The right-hand side is a traditional Phillips curve graph with the rate of price change on the vertical axis and the rate of unemployment measured along the horizontal axis.

A collection of predictions in 1980 would be certain to include those made by members of the New Classical School, who would argue that a tightening of policies immediately lowers inflation with no loss of output. On the Phillips curve this would correspond to a

[7] A more detailed discussion of various schools of thought will be presented in Section II below. The definitions adopted are not universally accepted. For instance, Tobin (1980) refers to the New Keynesian School as the "Neoclassical Synthesis", while the New Classical School becomes "Monetarism 2", with "Monetarism 1" referring to Friedman's theory of money as the key determinant of nominal and real income. At the same time, Greenwald and Stiglitz (1988) confine the New Keynesian School to theories that focus on market imperfections, particularly in capital markets, while models explaining lags in wage and price behaviour are labelled "Traditional Keynesian Theories".

[8] See also Budd and Dicks (1982).

move from A to B along the vertical curve while on the left-hand side actual output would always equal potential output (AQ*).

Traditional Keynesians, on the other hand, would see a move from A to C on the downward-sloping Phillips curve and in the output diagram a move from A to C along the curve (a). Hence there would be loss of output during the period of adjustment and the economy would end up at a level of output below potential (and a higher level of unemployment) when inflation had been reduced to the desired target. This outcome would also be predicted by members of the hysteresis school, according to whom potential output gradually adjusts to actual output. Thus AQ* would gradually shift down and the vertical Phillips curve AB would move to the right until it reaches point C.

New Keynesians, influenced by Friedman's and Phelps' critique of the long-run trade-off, as well as members of the Monetarist School would predict a movement from A to B along (b) and in the Phillips curve graph a move from A to C along the short-run Phillips curve and then a shift from C to B. Thus the economy would eventually return to the potential output path at full employment, but there would be costs to lowering inflation in terms of output losses and higher unemployment during the intervening years. Path (c) gives a more optimistic view of the likely development, as the output loss incurred early in the adjustment is made up in the later phase. On the right-hand side this would involve some overshooting of the long-run unemployment rate, and to achieve this the inflation rate would have to "undershoot" the target rate during part of the adjustment. Although a precise offset of the output losses during the early phase is an unlikely outcome many macro models of the New Keynesian or Monetarist School have a dynamic structure which produces a considerable degree of overshooting and the outcome of policy simulations frequently follows a path such as (c).

Along the adjustment path (d) the early output loss is not only offset, but the economy ends up at a higher level of real output and possibly also a higher rate of potential growth. The vertical Phillips curve would now shift to the left and the equilibrium rate of

unemployment declines. Who would have predicted such an outcome? It is difficult to associate (d) with any particular school of thought, but it is consistent with the view held by many policy-makers that inflation is a cause of low output and that a precondition for permanently raising output (and lowering unemployment) is a lower rate of inflation. One argument supporting this view is that at high rates of inflation price signals are difficult to interpret and this hampers output growth.[9]

Finally, path (e) provides the most favourable outcome and may correspond to the view held by supply-side economists, who gained political influence in 1980. According to this school, appropriate supply-side measures would lower inflation and raise the rate of output growth without any need for restrictive measures. The emphasis on the efficiency of market forces is very similar to that of the New Classical School, and the measures proposed by the supply-side school may be seen as removing obstacles and lifting the economy from a second-best equilibrium to a more satisfactory one.

How do the fourteen countries "fit" the hypothetical adjustment paths? Returning to Table 2, a first impression is that the United States has followed the path of the revised Keynesian model, as the rate of unemployment is now lower than in 1979–80 whereas the rise in output growth has not been sufficient to offset the earlier deviations between actual and trend output. Moreover, Sweden seems to "fit" model (d), with a marked deceleration in inflation, no change in the rate of unemployment and only a small output loss. However, a surprisingly large number of the remaining countries have followed the traditional Keynesian path, with an apparently permanent rise in the rate of unemployment and a large cumulative output loss. This picture is clearly observed for Germany, France, the United Kingdom, Italy, Belgium and the Netherlands. Switzerland,

[9] See, for instance, Friedman's (1977) Nobel Prize Lecture. Some would also argue that potential output growth in the United States and the United Kingdom is higher now than in 1980. However, neither country has evolved along path (d) and a possible rise in potential output growth may have other causes than the fall in inflation.

Austria, Australia, Denmark, Canada and Japan also come close to this path, although the rise in unemployment and the output loss are much smaller than in the first group of countries.

In evaluating the adjustment paths, the approximate nature of some of the measures given in Table 2 should, of course, be taken into account. It is well known that measures of unemployment differ across countries and some of these differences will also influence changes in unemployment. The cumulative output losses are even more uncertain, as they are very sensitive to the assumed potential growth rates.[10] It is also important to recall the earlier observation (p. 12) that the degree of disinflation has been largely independent of the incurred output and employment losses. This implies that simple explanations or theories based on average figures for a large number of countries (such as Graph 1) are risky, since they overlook the influence of country-specific factors as well as the existence of non-linear relationships. Nevertheless, the table does reveal a rather marked difference between the United States, on the one hand, and the major European countries, on the other, with Japan, Canada and some of the smaller European countries occupying intermediate positions.

(d) Transmission Mechanism. A more analytical problem relating to Table 2 is that it is silent with respect to the underlying transmission mechanism. Moreover, it does not reveal how much of the observed deceleration in price increases can be ascribed to policy measures and how much was due to other factors, such as falling oil and non-oil commodity prices.

A recent "counterfactual" simulation of the OECD Interlink Model is instructive in this respect. By assuming that money supply growth over the period 1980-87 had been high enough to maintain nominal interest rates at their 1978 levels, the following cumulative

[10] For the seven larger countries the potential growth rates were calculated as simple averages of estimates by the IMF and OECD. For the smaller countries only OECD estimates are available and in the case of Australia this was adjusted upwards in view of the rapid growth of the labour force.

changes in relation to a base line solution were calculated for the total OECD area:[11]

		1980–83	1980–87
	dP	6.6	15.0
	dQ	3.7	2.3
	dU	−2.9	−4.3
Memo items:			
	dP/dQ	1.8	6.5
	dP/dU	−2.3	−3.5

Thus, for the seven-year period the tightening of monetary policy is estimated to have reduced inflation by a cumulative 15% (i.e. the price *level* is 15% below what it otherwise would have been), which is about half the actual decline. Moreover, the trade-off between inflation and output (dP/dQ) grows more favourable over time as output gradually recovers after the initial policy shock. In a second simulation the fall in oil prices is estimated to have reduced the price level by only 6.6%, thus pointing to a dominating influence of monetary policies.

Such simulations are generally useful in evaluating the impact of policy changes, but the outcomes in this case may overstate the influence of policies. In the first place, the implied trade-offs are rather favourable compared to those found in alternative studies. In a well-known survey of US models Okun (1978) calculates a trade-off between inflation and unemployment of only 0.3[12] and Gordon (1987a) estimates "sacrifice ratios"[13] for the United States, Japan and Europe of 6.5, 1.3 and 4.8 respectively, compared with only 1.8 in the OECD simulation.

[11] For further details see Coe et al. (1988).

[12] According to Friedman (1988) the trade-off for 1980–81 to 1986–87 at 0.4 was slightly more favourable. However, part of this gain can be ascribed to the appreciation of the US dollar over this period and was, therefore, only transitory.

[13] The sacrifice ratio is calculated as the cumulative loss of GDP (as a percentage of GDP in the initial year) divided by the permanent reduction in the rate of inflation. Okun (1978) puts the sacrifice ratio for the United States at 6–18, with an average value of 10.

Secondly, the principal transmission mechanism of the Interlink model are wage equations specified as Phillips curves with no long-run trade-off and mark-up price equations with the mark-up depending positively on aggregate demand. The model also includes an equation for non-oil commodity prices, in which lower output growth and inflation in OECD countries dampen the rise in commodity prices. The simulations discussed above thus include an influence of monetary policies on commodity prices, but their separate contribution to the deceleration may be understated compared with those ascribed to excess supply in labour and final goods markets. Indeed, two important papers[14] based on pooled cross-country and time series data conclude that changes in the rate of inflation can be entirely ascribed to developments in oil and non-oil commodity prices whereas the degree of slack in labour and final goods markets has no influence. Although this is an extreme view and too much influenced by the long-run nature of the estimates, it is nevertheless of some relevance given the recent interest among policy-makers in commodity prices as an early indicator of inflation.[15] Moreover, the policy implications are very different from those of more traditional theories of the transmission mechanism. Thus for all industrialised countries a fall in the rate of inflation can only be achieved if they act as a group, as most individual countries

[14] See Bruno (1980) and Beckerman and Jenkinson (1986). Both studies are based on reduced form equations with changes in consumer prices and nominal wages respectively as the dependent variable and import prices and the rate of unemployment included among the determinants. The authors recognise that the fall in oil and non-oil commodity prices is partly induced by weaker demand growth in the industrialised countries, but do not attempt to quantify this effect.

[15] Two recent studies may be seen as "compromises" in this respect. Thus in analysing the slowdown in UK inflation between 1979–81 and 1981–85 Rowlatt (1988) ascribes 28% to the fall in commodity prices and 72% to output and labour market slack. Boughton and Branson (1988) test the influence of commodity prices on changes in the average inflation rate for the G-7 countries and conclude that they improve the explanatory power of their equation as well as its predictive power for the period 1984–87. By contrast, the inclusion of money supply growth worsens the predictive power.

are too small to influence world commodity markets. Single countries adopting anti-inflationary policies will, though, experience some fall in the rate of price increase, but it will be entirely at the expense of other countries, since the only means of lowering inflation is an appreciation of the exchange rate.

II. Theories of the Wage-Price Mechanism[16]

The evolution of theories of the wage-price mechanism during the post-war period may be divided into four broad phases: the consensus of the 1960s, the breakdown of the Keynesian paradigm, the new classical era and the reconstruction of Keynesian theories.

(a) The Consensus of the 1960s. An essential feature of Keynesian macroeconomics is the notion of slowly changing prices and wages and non-clearing markets. In the "General Theory" Keynes (1935) assumed that nominal wages were "sticky" and prevented the labour market from clearing while output prices were flexible.[17] The model was developed in a static setting, but the discovery of the Phillips curve [Phillips (1958)], which postulates a relationship between changes in nominal wages and the rate of unemployment, made it possible to "dynamise" the wage-price mechanism. At the same time, it provided the "missing link" to the IS-LM model. This is illustrated in the graph on p. 21, where a shift of the LM curve (due to a more expansionary monetary policy) raises real output from Q_1 to Q_2, but at the same time increases the rate of inflation from dP_1 to dP_2. Thus the famous trade-off between output and the rate of inflation was born, and a principal assumption of virtually all macro models of the

[16] Readers interested in more detailed surveys of inflation theories are referred to Laidler and Parkin (1975), Barro and Fischer (1976), Frisch (1977), Santomero and Seater (1978), Blanchard (1987b), McCallum (1987a) and Fischer (1988).

[17] These assumptions meant that the goods market always cleared while real wages followed a counter-cyclical pattern. However, as pointed out by Dunlop (1938) and Tarshis (1939) and recognised by Keynes (1939), this pattern is not supported by empirical data.

1960s was that the trade-off was permanent;[18] i.e. a change in money supply and nominal demand had permanent real effects.[19]

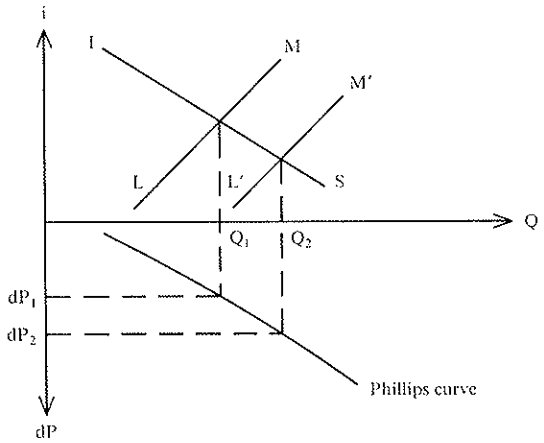
The old Keynesian model as illustrated in Graph 3 makes use of two additional equations, which characterise a US tradition as distinct from a European one. Thus the original Phillips curve postulated a relationship between nominal wage changes and unemployment, but assuming that prices are set as a constant mark-up on trend unit labour costs and that there is a linear relationship between excess supplies in labour and product markets – the Okun equation [see Okun (1962)] – it is easy to transform the Phillips curve into the curve shown in the graph. For the United States the two additional equations were consistent with empirical data and, after the addition of a few supply-side variables to the price equation, they have proved surprisingly robust until this day. For other countries the Okun equation has been much less stable and the above price equation is subject to two major shortcomings.[20] First of all, in a small open economy price changes will not only depend on changes in unit labour costs but also on the development of export and import prices. Secondly, when prices are set as a constant mark-up on unit labour costs, real wages will rise in step with labour productivity and the distribution of factor income will, except for cyclical influences, be constant. However, outside the United States, changes in the distribution of factor income have been pronounced and distributional issues have played a prominent role in modelling the wage-price mechanism. Two models of this kind, which may be seen as complementing the simple Phillips curve framework, are of particular interest in this respect.

[18] See, for instance, Duisenberry et al. (1965), Tables 9.7 and 9.8.

[19] The graph is slightly incomplete and misleading in this respect. The IS-LM model augmented by a Phillips curve implies that a *one-time* rise in money supply will eventually be fully reflected in the level of prices and leave real output unchanged. The trade-off implied by the Phillips curve requires a *permanent* rise in the rate of growth of money supply.

[20] There are other shortcomings such as the assumption of a constant mark-up and the neglect of changes in capital costs, which will be discussed at a later stage.

Graph 3



(i) Scandinavian Model of Inflation. In the early 1960s the French economist R. Courbis[21] constructed a wage-price model with nominal wage changes determined along a Phillips curve and prices constrained to follow import prices in the long run. The model also introduced a distinction between exposed and sheltered sectors which was later taken up in the Scandinavian literature and became a main feature of the Scandinavian Theory of Inflation.[22] According to this hypothesis nominal wage changes in the exposed sectors are not to exceed the rise in export prices plus productivity growth (both of which are assumed to be exogenous) while in the sheltered sectors wage changes follow those of the exposed sectors and prices are set as a mark-up on unit labour costs. Despite the name, the Scandinavian

[21] See Courbis (1980) which contains references to earlier work.

[22] See Aukrust (1977) and the survey in Frisch (1977). A main difference between the Courbis model and the Scandinavian model is the underlying transmission mechanism. In the former, international prices influence domestic prices through the import competing sectors, whereas in the Scandinavian model changes in foreign prices are transmitted via the reaction of wages to export prices.

Theory is not really a theory of inflation[23] but mainly a set of conditions for balanced growth. However, it underlines an important link between international and domestic price developments, which is missing from the US consensus model and which implies that the long-run trade-off is compressed into a single point on the Phillips curve.[24]

(ii) Real Wage Hypothesis. In 1964 the British economist J.D. Sargan proposed a wage function based on the assumption that wage earners or their unions bargain for a certain level of real earnings. This adds the lagged level of real earnings to the traditional Phillips curve and this additional element acts as a "catch-up" term, boosting wage changes when real earnings have fallen below the target but dampening wage inflation when past negotiations have brought the level of real earnings above the target. Initially, this model did not attract much attention outside the United Kingdom, and it virtually broke down when exposed to the wage explosion following the first oil price shock. However, it has had a renaissance during the 1980s and, as will be discussed in Section IV below, may be an element in explaining the current labour market situation in the United Kingdom as well as in continental Europe.

[23] In fact, when exposed to empirical tests, the model has not performed particularly well, nor has it played any major role in wage negotiations for which it was initially designed. A recent update [Faxén et al. (1988)] introduces the following changes to the model: (i) the sheltered sector is disaggregated into a private and a public sector; (ii) productivity changes are endogenised; and (iii) the price mechanism is re-examined with a distinction between raw material, industrial and consumer markets replacing the earlier distinction between domestic and foreign prices. Previously Gärtner and Ursprung (1981) had estimated a Scandinavian model for Switzerland and found two interesting but disturbing features: (i) the reaction of trade prices to exchange rate changes is not instantaneous (as for changes in World prices) but subject to lags of up to three years; and (ii) when augmented by a monetary sector to explain movements in interest rates and exchange rates, the model tends to become unstable.

[24] This may be seen from Graph 3. If changes in world prices equal dP_2, output cannot deviate from Q_2, as output levels above (below) Q_2 would be accompanied by a deficit (surplus) on the current external account. For further discussion see Frisch (1977).

(b) Breakdown of the Consensus Model. The Consensus Model and the policies based on the assumption of a permanent trade-off between inflation and unemployment received several serious blows in the early 1970s. First a tightening of policies in the United States did not produce the expected decline in inflation and subsequently an upsurge in oil and non-oil commodity prices led to a rise in both inflation and unemployment. In retrospect, these episodes revealed some serious flaws in the model, which, moreover, by giving the wrong signals to policy-makers contributed to its own undoing. As an illustration consider the following simple model of the wage-price mechanism:

(i) $dw_t = a - bU_t + cdp_t + edp_{t-1}$

$dp_t = dw_t - \overline{dq}$ with

dp = percentage change in consumer prices

dw = percentage change in nominal wages

dq = trend productivity growth

U = rate of unemployment

t = time, measured in years.

If b = c = 0.25 and e = 0.5 (not atypical parameters for US wage functions of the 1960s) the first-year impact of a 1 percentage point decline in unemployment would be a rise in dw of only 0.25 of a point. Because of the feedback between wages and prices dw would rise more in the second year, but owing to the slow response of wages to prices dw would only very slowly approach the final rise of one point. Moreover, if U is successively lowered – as happened in the United States during the 1960s – there will be a gradual build-up of lagged effects which is likely to go unnoticed by policy-makers. In such circumstances it is not surprising that a 1½ point rise in U – as between 1968 and 1970 – will not reduce actual wage increases as they are dominated by the influence of previous declines in U. In other words, a policy-induced move along the Phillips curve will be more than offset by an upward shift of the curve due to the momentum of inflation.

A second shortcoming concerns the aforementioned neglect of foreign prices in the price function. When import prices suddenly increase by more than 40% in one year domestic prices will not be unaffected even in a large and relatively closed economy such as the United States. Moreover, this price acceleration feeds into wages, so that if policies are tightened in an attempt to dampen the influence of foreign prices, there is likely to be a rise in both U and dw. This clearly leaves the impression that the trade-off has become useless as a tool for policy-makers, though later analyses have shown that the Phillips curves used at that time were merely too simplistic and could be "rescued" by adding some of the missing variables.

However, a more serious flaw in the model was the underlying theory of a long-run permanent trade-off. As argued by both Friedman (1968) and Phelps (1968) it is implausible to assume that a society can enrich itself in real terms by printing money at a high rate. Instead, the Phillips curve should be specified as a relationship between expected *real* wage changes and the rate of unemployment. This may be illustrated by assuming that price expectations are formed adaptively and can be written as a weighted average of the one and two-year lagged rate of price changes. The wage equation (i) then becomes:

$$\text{(ii)} \qquad dw_t = a - bU_t + cdp_{t-1} + (1-c)dp_{t-2}$$

When combined with the previous price equation, (ii) can be rewritten as:

$$dw_t = a - bU_t + cdw_{t-1} + (1-c)dw_{t-2} - dq$$

so that to keep the rate of inflation stable, the following condition must be satisfied:

$$a - d\bar{q} = bU \quad \text{or}$$
$$U^* = (a-d\bar{q})/b$$

U* is Friedman's "natural rate" and the absence of a long-run trade-off is frequently referred to as the "Natural Rate Hypothesis" (NRH). U* is also the "non-accelerating inflation rate of unemployment" (NAIRU), but this is a special case and, as will be further discussed in Section IV below, the NAIRU and the natural rate differ conceptually as well as empirically. For the time being, however, we shall ignore these differences and use U* for both concepts.

(c) New Classical Model. The NRH has now been adopted in virtually all models of the wage-price mechanism. By contrast, the short-run trade-off is controversial. It survived the objections by Friedman and Phelps and is retained in the above formulation but is rejected by the members of the New Classical School. One of their objections to the Phelps-Friedman model was the assumption that price expectations are formed adaptively [Lucas (1972)]; instead, they argue, rational agents form expectations on the basis of all currently available information including policy announcements and changes. Secondly, members of the New Classical School assume that prices clear product markets instantaneously and that each firm is a price taker.[25] Consequently, and despite its importance to the discussion of models of the wage-price mechanism, the New Classical Model is not really a model of inflation but rather a model of supply determination. For example, according to Lucas (1973) firms raise output when they perceive their own price to exceed the expected average price level. At the aggregate level this implies that actual

[25] Another feature of the New Classical Model which affects not only the wage and price equations but all behavioural equations of a given model is the assumption that behavioural parameters are influenced by changes in the policy regime. This is also known as the Lucas critique [see Lucas (1976)] and, like Goodhart's Law and Fellner's Policy Credibility Hypothesis, questions the validity of all models based on policy invariant parameters. Together with the other two assumptions of the New Classical Model, Lucas' critique leads to the Policy Ineffectiveness Proposition which denies any real effects of policy changes unless they are unanticipated. In practice, the proposition has been difficult to verify partly owing to the problem of clearly identifying changes in policy regimes.

output (Q_t) exceeds potential or equilibrium output (Q^*) when the current price level (P_t) exceeds some expected level (P^*), thus producing a short-run aggregate supply curve with a positive slope.[26] Empirically, Lucas implemented the model by using current changes in nominal income ($d\hat{y}_t$, measured as a deviation from trend real output growth) as a proxy for P_t/P^* and Q_{t-1}/Q^* was added to account for lags ascribed to imperfect information:

(iii) $\quad d(Q_t/Q^*) = a + bd\hat{y}_t + c(Q_{t-1}/Q^*)$

b can be interpreted as the slope of the short-run supply curve and Lucas assumed b to vary inversely with the volatility of aggregate nominal demand on the grounds that in conditions of general uncertainty firms are less likely to change output.

The above model has been extended to include more countries than Lucas' original eighteen and has also been tested on different time periods. The results have been mixed, as b varies a lot and not always as predicted by the model. Moreover, most of the explanatory power is associated with Q_{t-1}/Q^* implying a highly autogressive output structure, which is inconsistent with the underlying assumption of market clearing. To overcome some of these problems, Barro in a series of papers (1977, 1978 and 1980) tested a different empirical version of the Lucas model. Instead of proxying P_t/P^* by $d\hat{y}$, he assumed that a rational agent would base his price expectations on *anticipated* changes in money supply and that only *unanticipated* money supply changes would have real output

[26] This appears to be similar to the Phillips curve except that the line of causality has been reversed. However, since both output and prices are in levels and measured as deviations from expected values, the two models are only equivalent under very restrictive assumptions with respect to the expectation formation process [see Borio and Rankin (1988)]. In an earlier paper with Rapping [Lucas and Rapping (1969)], Lucas had postulated a similar model for the labour market, where he also introduced the concept of inter-temporal substitution. This states that wage earners who perceive the current real wage to be below some future expected rate voluntarily opt for more leisure, thereby raising the measured rate of unemployment.

effects.[27] Using a policy reaction function to derive anticipated money supply changes and replacing Q_{t-1}/Q^* by other variables, Barro found his hypothesis confirmed by US data, though for both his output and price equations there were long lags not accounted for by the theory. However, subsequent studies have shown that Barro's results are very sensitive to the measurement of anticipated and unanticipated money supply changes and to the monetary aggregate being used [Mishkin (1982)]. Moreover, a model combining the NRH with lagged price adjustments outperforms those implying policy ineffectiveness for both the United States [Gordon (1982)] and the United Kingdom [Demery (1984)]. Finally, Barro's model is decisively rejected [Pigott (1978) and Fitzgerald and Pollio (1983)] when tested on data for Japan and large countries other than the United States and [Duck (1988)] also when applied to cross-country data for industrial and less developed countries. Consequently, and despite its intuitive appeal and relevance to monetary policy, this particular line of research appears to have arrived at a dead end and has been abandoned by the original author.[28]

[27] See footnote 25 above. In this context it may also be recalled that the relationship between money and real output has a long history in empirical macroeconomics. One of the major findings in the monumental study by Friedman and Schwartz (1963) was the stable relationship between money and real GDP. This also played a major role in the so-called St. Louis equation [Andersen and Jordan (1968) and the survey articles in the October 1986 issue of the Federal Reserve Bank of St. Louis *Review*] and the ensuing debate. In the early 1970s Sims (1972) sparked off a new round of discussions using more sophisticated econometric methods based on the Granger causality test. At first, this seemed to confirm the earlier results by Friedman and Schwartz, but as more variables were added to the model, including the rate of interest [Sims (1980)], the line of causality became more difficult to identify. It is also interesting that, when examining the leading indicators for the United States, Koch and Rasche (1988) find that the only ones which display a substantial average lead and explain a significant part of the variations in industrial production are real M2 and total liquid assets.

[28] Barro's hypothesis is also subject to the objection that it is biased towards the sellers' side of the market. Thus buyers who perceive current prices (and the anticipated money stock) to be above some normal level would reduce demand and thus cause a fall in real output.

Does this mean that the New Classical Model has nothing to offer in explaining the wage-price mechanism? At first sight it appears so. Thus there remains a "hard core", the so-called real business cycle theorists, who have maintained the market-clearing assumption and see variations in Q_t/Q^* as entirely due to real disturbances and as independent of actual or perceived price developments. In fact monetary and fiscal policies have no real effects in this model and changes in money supply are seen as passively adjusting to real output changes.[29]

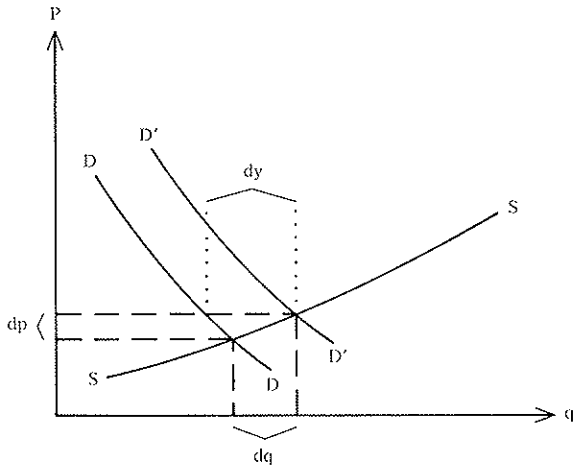
However, indirectly the Lucas model has influenced some of the more recent studies of the Keynesian tradition and helped to shift the emphasis from wage to price behaviour and eventually to the aggregate supply curve with a long-run relationship between the *level* of prices and the *level* of output. As mentioned above, the b-coefficient in Lucas' equation can be interpreted as the slope of the short-run aggregate supply curve as it indicates the response of real output ($d\hat{q} = d \log Q/Q^*$) to a change in nominal demand ($d\hat{y}$), see Graph 4. However, instead of deriving the slope from the response along the output axis, it might as well be measured along the price axis. This is the approach adopted by Gordon (1981), who further drops the assumption of market-clearing and price-taking firms. Moreover, recognising the slow adjustment of prices, dp_{t-1} is included as an additional variable, giving the following equation for estimation:

$$\text{(iv)} \quad dp_t = a' + b' d\hat{y}_t + c' (Q_{t-1}/Q^*) + e' dp_{t-1}$$

Gordon's estimates were confined to the United States and covered almost 100 years. The results were plausible, with the parameters largely stable except for e', which rose sharply for the last thirty years, suggesting that the introduction of three-year contracts in the

[29] Readers interested in this particular branch of the New Classical School are referred to the March/May 1988 issue of the *Journal of Monetary Economics*, which is devoted to a conference on the real business cycle.

Graph 4



unionised sector led to longer lags in the adjustment of prices. Other authors [Coe and Holtham (1983) and Schultze (1984 and 1986)] have extended the model to other countries and mostly found rather plausible and stable parameters. The model is also analytically appealing in that $(1-b')$ indicates the extent to which prices *fail* to clear markets in the short run (see also p. 38) while c' captures the traditional Phillips curve effect.

Yet this approach is not wholly satisfactory and four weaknesses (also relevant to equation (iii)) in particular should be mentioned:

(i) Unbiased estimates of the behavioural parameters can only be obtained when the aggregate demand curve has an elasticity of unity and the supply curve is not subject to shifts.[30] The former assumption is very restrictive and the second is clearly implausible, given the large changes in oil and non-oil commodity prices during the 1970s.

[30] For proof see Asak (1977). Ball et al. (1988) suggest a way around this problem, arguing that if the aggregate demand elasticity (e) differs from unity $edp + d\hat{q}$ will be independent of supply shocks. Equation (iv) (or (iii) in their version) is then estimated for e ranging from 0.5 to 2.

(ii) Even if the above assumptions were satisfied, the estimated b′-coefficient is likely to be biased, as the national accounting identity implies that dp is already contained in dŷ. This bias could be eliminated by transforming equation (iv)[31] but, as can be seen from Table 3 below, this leads to much less satisfactory estimates. For instance, while equation (iv) implies that a rise in money supply which increases nominal demand growth by 1 percentage point will be accompanied by a short-run real output rise of 0.66–0.74 points, the alternative and unbiased approach yields very poor results, with only the German supply elasticity being close to statistical significance.

(iii) In an open economy policy-induced shifts in the aggregate demand curve should be approximated by changes in domestic demand and not by changes in nominal income. However, since a rise in domestic demand can be met by higher imports (and/or lower exports), higher domestic output or higher prices, it is not enough to substitute changes in domestic demand for changes in nominal GDP, but import demand should also be included. This probably explains why the slope parameters tend to be less well determined for smaller than for larger countries.

(iv) The model ignores wages and hence the specific contribution of the wage formation process to lags and cyclical sensitivity.

In a second "Keynesian" application of equation (iii), Ball et al. (1988) maintain Lucas' specification with output as the dependent variable, but assume that the slope of the aggregate supply curve not only depends on the variability of nominal demand but also on the average rate of inflation. The rationale behind this argument is that in countries and periods with high rates of inflation firms will adjust prices more frequently than in conditions of low inflation, whereby the "split" between price and real output changes shifts towards the former. When interpreted within the Phillips curve framework, this hypothesis has the interesting implication that the Phillips curve becomes flatter at high rates of unemployment, thus suggesting a less

[31] Using the national accounting identity $d\hat{y}_t = d\hat{q}_t + dp_t$, (iv) can be rewritten as:

(v) $dp_t = (a' + b' d\hat{q}_t + c' (Q_{t-1}/Q^*) + c' dp_{t-1})/(1-b')$

so that the parameters will be larger than in (iv) but none should change sign.

Table 3
Output Price Equations* (Selected countries, annual data 1960–81)

Countries	$d\hat{y}$	$d\hat{q}$	Q_{-1}/Q^*	dp_{-1}	R^2	h
US (iv) ...	0.26 (2.4)	–	0.12 (1.4)	0.67 (6.9)	0.87	0.65
(v) ...	–	0.01 (0.1)	0.07 (0.7)	0.77 (6.4)	0.83	−1.33
JP (iv) ...	0.34 (2.6)	–	0.12 (1.5)	0.27 (2.1)	0.73	0.04
(v) ...	–	−0.05 (0.3)	0.23 (2.8)	0.18 (1.0)	0.61	1.28
DE (iv) ...	0.28 (3.7)	–	0.26 (2.7)	0.05 (0.3)	0.64	0.65
(v) ...	–	0.20 (1.5)	0.35 (2.9)	0.00 (0.1)	0.56	2.26

* In addition to the parameters shown, the estimated equations include intercept terms and the change in import prices (United States and Japan) or a dummy shift variable (Germany) to correct for shifts in the aggregate supply curve. R^2 is the coefficient of determination. h is Durbin's measure of autocorrelation with critical values of ± 2 and t-statistics are given in brackets.

favourable trade-off for anti-inflationary policies in the 1980s than in the 1970s.

Ball et al. test the hypothesis by first estimating b in equation (iii) for each of forty industrialised countries and then regressing the b-coefficients on the corresponding values for average inflation and the variability of demand. They find their thesis confirmed for the period 1960–84 as well as for various sub-periods and sub-samples of countries. They do not apply their test to time series for individual countries, and when we tested the hypothesis on data for the three largest countries the results were mixed. For the Lucas equation the estimates for the United States and Germany confirmed the postulated impact of inflation, but it was rejected for Japan. Moreover, for equation (iv), which is more consistent with the underlying hypothesis of imperfect competition, the hypothesis was rejected for all three countries.[32]

[32] The test was done on annual data for the period 1960–86 and carried out by setting the coefficient on $d\hat{y}$ in (iii) and (iv) equal to $(b + h/dp_{-1})$ and subsequently checking the sign and statistical significance of h. It was also applied to a wage equation over the same period, using the specification:

$$dw = a - (b + h/dp_{-1}) \log U + e\, dp + f\, dp_{-1} + g\, dq$$

but again h was found to be statistically insignificant. The non-linear form as well as the lag on the postulated impact of inflation on the split follows suggestions in Ball et al. However, the lag may not have been sufficiently long if firms adjust their pricing behaviour only slowly.

In conclusion, Gordon's model was an appealing and promising attempt to quantify the notion that policy changes mainly influence nominal income while the split of nominal income changes between price and output changes is determined by market forces, as captured by the slope of the aggregate supply curve. It also gives a more satisfactory explanation of price and output variations than a model based on the assumption of instantaneous and continuous market clearing, and Ball et al. add a further and highly policy-relevant element to the split by postulating a dependence on the rate of inflation. However, the model is a "short-cut" to quantifying the supply side and the empirical support for the specific influence of inflation is still in doubt. Moreover, because the parameters are reduced forms of the underlying behavioural parameters they are not very robust. Consequently, most recent discussions have concentrated on the characteristics of the principal structural or behavioural equations, viz. the parameters of the price and wage adjustment functions.

(d) New Keynesian Models. The New Keynesian Models of the wage-price mechanism have retained the assumption of sluggish price and wage adjustments and non-clearing markets, but have adopted the notion of a long-run vertical Phillips curve[33] as well as the new classical assumption of rational expectations and optimising agents.[34] While the empirical evidence on non-clearing markets is

[33] One exception is the so-called "norm model" proposed by Okun, Perry and Schultze [see Perry (1986)], which may also be interpreted as an extreme version of nominal rigidity (see below). According to this hypothesis, wage earners seek to obtain a certain norm increase in nominal wages, based on a loose notion of what the "going rate" should be. Technically, the hypothesis implies that a constant term, subject to shifts over time, is added to the wage equation shown below and the model is implemented by using dummy variables, pre-selected according to the analyst's views of when a norm shift may have occurred. This usually has the effect that the coefficients on the price terms decline sharply or become insignificant.

[34] As pointed out by Solow (1979a) the difference between the New Classical Model and the New Keynesian Model is *not* that the first assumes optimising agents while the second does not. The difference is in the *constraints,* which firms are likely to take into account.

quite firm, a major theoretical challenge to the New Keynesians has been to explain why in a world of rational agents markets do not clear. During the last decade a large body of literature has been devoted to this question. However, before reviewing the principal hypotheses it is helpful to make a detour and introduce the concept of rigidities which has figured prominently in this literature. In particular, two questions will be addressed: (i) how are rigidities defined and (ii) what is the importance of rigidities to policy-making and, in this context, would more flexible wages and prices be helpful?

(i) Price and Wage Rigidities.[35]

Definition of real and nominal rigidities.

A frequently heard argument when characterising economic behaviour in various countries is that wage formation in the United States has a high degree of nominal rigidity whereas Europe suffers from rigid real wages. Although there is no unified theory of rigidities [see Mitchell (1986) and Helliwell (1988)], the behavioural parameters involved may be identified from the following wage and price equations:

(vi) $dw_t = a + bdp_t + (1-b)dp_{t-1} - c(U_t - U^*) + e\,dq$

$$dp_t = f + j(g(dw_t - dq) + (1-g)(dw_{t-1} - dq)) + (1-j)dpm_t + iQ_t/Q^*$$ [36]

Most analysts define *nominal* rigidities as a slow response of wages and prices to current changes in nominal variables and measure

[35] The discussion in this section is confined to aggregate wage and price rigidities. A related but separate issue concerns the rigidity of sectoral and/or regional wage and price differentials.

[36] The price equation is frequently rewritten as:
$dp_t = f/j + g(dw_t - dq) + (1-g)(dw_{t-1} - dq) + ((1-j)/j)\,(dpm_t - dp_t) + (i/j)\,Q_t/Q^*$
on the assumption that import prices only affect domestic prices when their rates of change differ.

the *degree* of nominal rigidity as (1−b) or (1−g) depending on the equation considered. In practice, the lag structure will be longer than shown above but the important point is that as long as b and g are less than unity purely nominal changes will have real effects.

Real rigidities, on the other hand, are usually associated with a weak response of wages and prices to real or cyclical changes, i.e. with low values for c and i. Most analysts of real rigidities have focused on the wage equation and – for reasons to be explained below – have measured the *degree* of real wage rigidity by 1/c or b/c.[37]

Rigidities and economic policy.

The importance of rigidities to economic policy-making is easier to explain if the two equations in (vi) are combined into a reduced form in prices. On the further assumption that $(U-U^*)$ is proportional to Q/Q^* and confining the analysis to the long run (vi) can be written as:

$$(vi') \quad ddp = a' + k(c+i')Q/Q^* + k((1-e)dq + j'(dpm - dp))$$

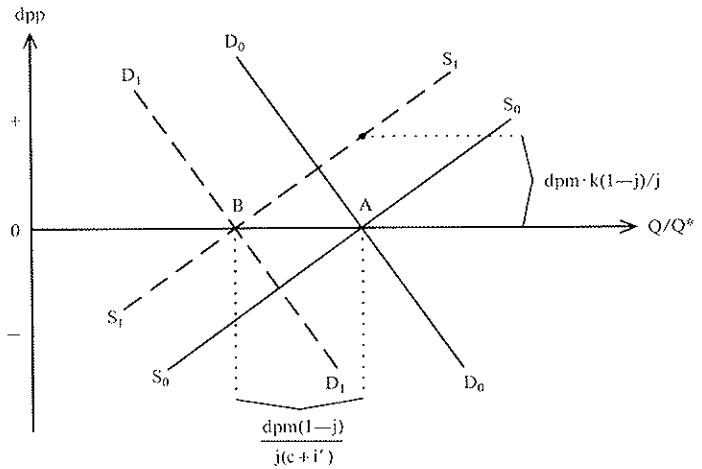
where $a' = k(f/j + a)$ $\quad j' = (1-j)/j$
$\quad i' = i/j$ $\quad k = 1/(1-bg)$

and ddp denotes *changes* in the rate of price inflation. (vi') may also be interpreted as a long-run aggregate supply curve with $k(c+i')$ indicating the slope and dq and (dpm − dp) serving as shift variables (see Graph 5).

From the above expression it is immediately seen that a high degree of *nominal* rigidity will tend to flatten the aggregate supply curve so that shifts in the aggregate demand curve will be

[37] These definitions implicitly assume that the price and wage equations are homogenous of degree one; (i.e. that the coefficients on prices and wages respectively in the wage and price equations sum to unity). The definitions can still be used when this condition is not satisfied but the empirical measures are more difficult to interpret.

Graph 5



accompanied by relatively large output effects and only small changes in the rate of price inflation. By contrast, when wages and prices respond quickly, the output effects of changes in demand will be relatively small and it was against this background that Friedman (1974) and Giersch (1974) recommended wage indexation as a means of reducing the output costs associated with anti-inflationary monetary policies.[38] However, as shown by Gray (1976) and Fischer (1977), the stabilising influence of wage indexation very much depends on the kinds of shock experienced. In the case of a supply shock a quick response of wages to prices is undesirable, since the

[38] This recommendation, as well as the analyses by Gray and Fischer, implicitly assumes that price expectations adjust slowly, so that wage indexation increases b in equation (vi). If, however, price expectations adjust rapidly or are very volatile with a tendency to overshoot, analysing the impact of wage indexation will require a different model.

maintenance of output on a non-inflationary path requires real wages to "absorb" changes in productivity growth and in relative import prices. This can also be seen from the last two terms in (vi'), as a high value for b (and k) leads to larger shifts in the aggregate supply curve and thus exacerbates the inflationary impact of changes in $\dot{dq}$ and dpm.[39]

Turning to real rigidities, it is easily seen from equation (vi') that real rigidities tend to flatten the aggregate supply curve just like nominal rigidities. Hence, when the degree of real rigidities is high, demand shocks are accompanied by large fluctuations in real output but relatively small changes in the rate of inflation. More important, however, is the implication of real rigidities for policies aimed at keeping inflation stable in conditions of large and frequent supply shocks. This has been a main concern of the European literature in this area and may be illustrated by analysing the effects of a sudden acceleration in import prices. Depending on the weight of imports (1−j) a rise in (dpm−dp) has an immediate effect on domestic prices. Wages would also be affected and eventually the upward shift of the aggregate supply curve would reach k(1−j)/j times the relative change in import prices (see Graph 5). If the authorities wish to hold the rate of inflation stable, a more restrictive policy stance is required, as Q/Q^* would need to fall from A to B or by $(1-j)/j(c+i')$ times the change in (dpm−dp).[40] In a small and open economy with a high degree of real rigidity this tightening could be substantial. For

[39] Some also argue that the rate of inflation is higher in indexed than in non-indexed economies. The mechanism is often associated with the view that the authorities in countries with wage indexation tend to adopt more expansionary policies and it is further claimed that these countries adapted less well to the two oil shocks. However, using cross-country regresssions based on a sample of 40 countries Fischer (1983) contests the latter view and argues that countries with indexation in fact adopted less accommodating policies. Moreover, in an earlier survey of wage equations Goldstein (1975) did not find that indexation had any appreciable effect on the estimated parameters.

[40] Note that nominal rigidities affect the inflationary impact of higher import prices, but *not* the fall in demand required to eliminate the inflationary shock.

instance, when the import share (1−j) is 40% and the cyclical sensitivity of prices is close to zero (as found in many empirical studies) an import price shock of 10% would require that Q/Q* fall by 10% when c = 2/3, while for c = 4/3 the degree of tightening will be only 5%.[41]

A productivity shock could be treated in a similar manner. From the penultimate term of equation (vi′) it is seen that a 1 percentage point decline in dq shifts the aggregate supply curve up by (1−e)k and requires a fall in Q/Q* of (1−e)/(c+i′) to hold inflation stable. Again a relatively flat supply curve aggravates the output slack needed to offset the inflationary impact of an unfavourable supply shock.[42]

Against this background, many observers of the European situation have come to the conclusion that, if only real wages were (or had been) as flexible as in Japan and nominal wages as rigid as in the United States, employment and output would have been much higher. Observers of the American scene would agree that real wage flexibility is helpful in conditions of supply shocks but would also stress the policy implications of nominal rigidities and a flat aggregate supply curve when shocks originate on the demand side. Apart from these differences in emphasis, mainly reflecting recent policy experiences, a more serious problem with the above analysis is the simplifying assumption that the demand and supply curves are independent of each other. This is obviously a very restrictive assumption, but once a more realistic model is adopted the question of whether changes in the degree of real and nominal rigidities are desirable becomes even more intractable. Some recent studies have addressed this issue (thus reopening a debate which goes back many

[41] If the change in (dpm-dp) were only temporary, the fall in Q/Q* would be temporary as well, while for permanent changes Q* would fall, and the more so the higher the degree of real rigidities.

[42] When productivity changes are fully absorbed by wages (e = 1) inflation would remain stable, leading some analysts to use 1−e as a measure of real wage flexibility (see Gordon 1987a).

years[43]) using model simulations or numerical analyses and obtained results which modify some of the conclusions stated above.

As a first step, it may be assumed that the aggregate demand curve in Graph 5 is influenced by changes in real variables such as investment, exports and government expenditure as well as by changes in the real money stock. This implies that a move along the supply curve will induce shifts in aggregate demand via a real balance effect, and it increases the role of nominal rigidities when shifts of the aggregate demand curve are mainly the result of monetary changes [see Ball et al. (1988)]. This argument may be illustrated using the aggregate price equation (iv) on p. 28 with two additional assumptions, viz. that the coefficients on $d\hat{y}$ and dp_{-1} sum to unity and that fluctuations in $d\hat{y}$ are only due to changes in money supply (dm):

$$(iv') \quad dp_t = a' + b'\,dm_t + c'(Q_{t-1}/Q^*) + (1-b')dp_{t-1}$$

When $b' < 1$, changes in dm will be only partly reflected in prices and $(1-b')$ will appear as a change in real output. On the other hand, when $b' = 1$ and there is no nominal rigidity, changes in dm will have no effect on the aggregate demand curve as they are immediately eliminated by price adjustments.

While the above example "throws all the burden of adjustment" on nominal wages and prices, it is clearly an extreme case. Aggregate demand shocks of a real nature will also be present and cannot be eliminated by quick price adjustments.[44] Moreover, price changes do

[43] See Fisher (1923), who recommends that monetary policy should stabilise the price level, and Keynes (1935) Ch.19, who argues against wage and price reductions as a means of increasing real balances. Tobin (1975) was the first to draw a distinction between a stabilising price *level* effect and a destabilising price *change* effect (see below).

[44] A further complication is that nominal and real rigidities may not be independent of each other. This is discussed in Blanchard (1986), who uses a staggered wage and price model to obtain an equation similar to (iv') above (but without Q_{t-1}/Q^*). He then shows that under static expectations the degree of nominal rigidity depends directly on the real rigidity of prices and wages. He further proves that this dependence remains, though in weaker form, when expectations are formed rationally.

not only affect aggregate demand through real balances but also via real interest rates. This additional transmission mechanism has been included by De Long and Summers (1986b), who analyse the effect of more real wage flexibility on the variability of real output. In their underlying model aggregate demand is a positive function of real balances but a negative function of real interest rates, while the nominal wage is a positive function of expected prices and real demand. Under these assumptions a supply shock (for instance, a wage push, a fall in productivity or a rise in import prices) is accompanied by two effects (see below): a price *level* effect, which tends to lower output because real balances decline, and a price *change* effect, which boosts aggregate demand and output by raising inflationary expectations and lowering real interest rates. If the economy is initially in equilibrium, the first effect is destabilising, whereas the second is stabilising, and there is general agreement among analysts of this issue that a higher degree of real wage flexibility will increase the stability of the system. This concurs with the popular view that to the extent that Europe's problems started with the supply shocks of the 1970s more flexible real wages would have attenuated the decline in output and employment.

Output Effects of Increased Real Wage Flexibility

	Price level effect	Price change effect
Supply shock	Destabilising	Stabilising
Demand shock	Stabilising	Destabilising

However, in the event of a demand shock the conclusion is different. The price level effect is now stabilising, as the change in real balances partly offsets the initial demand shock, whereas the price change effect is destabilising. This is because the change in the price level affects inflationary expectations and creates a real interest rate effect which strengthens the impact of the initial demand shock. By simulating the model De Long and Summers find that for a wide range of parameter values a rise in real wage flexibility makes the

economy more unstable, thus confirming earlier fears expressed by Fisher, Keynes and Tobin.[45] They also argue [De Long and Summers (1986a)] that the decline in the cyclical variability of the US economy during the post-war period has coincided with a decline in real wage and price flexibilities. Although this issue is probably not yet settled, the most recent works highlight the importance of using an appropriate specification of the interrelationship between changes in demand and supply as well as the shortcomings of too simplistic models. For instance, from Graph 5 it would appear that with a flat supply curve most of the adjustment to shifts in demand falls on real output. In the more sophisticated model, however, the smaller inflationary response associated with the flat supply curve becomes the key transmission mechanism, as it helps to dampen fluctuations in aggregate demand.

The main conclusion to be drawn from the above discussion is that the desirability of more flexible wages and prices very much depends on the circumstances, particularly the types of shock to which an economy is exposed. This leaves policy-makers in a rather uncomfortable situation since the instruments available for influencing the behavioural parameters (for instance indexation) cannot easily be switched on and off. Moreover, a precondition for designing such instruments is that the rationale for existing rigidities is clearly understood. This is an area that has been neglected so far in this section, but will be taken up below, starting with theories of wage rigidities and turning then to price rigidities.

(ii) Theories of Nominal and Real Wage Rigidities.

Implicit contract theories. A key assumption of this hypothesis, which received much attention (mainly in the American literature) in

[45] An important assumption behind this result is that wages and prices have some degree of rigidity in the initial situation. In conditions of complete flexibility and market clearing, as in the New Classical Model, prices and wages are unpredictable and cannot affect real interest rates. For further discussion see King (1988) and De Long and Summers (1988).

the early to mid-1970s, is that workers are risk-averse while firms have an interest in holding down turnover costs. This serves to explain the establishment of long-run relationships between employers and employees and a weak response of nominal wages to imbalances in the labour market. However, the theory fails to explain variations in employment, and most versions ignore that a risk-averse worker would be more concerned about his real than his nominal income [see the survey by Rosen (1985)].

The role of unions. For many years labour market analysts have studied the influence of unions on wage differentials and employment conditions in different sectors of the economy. More recently, unions' role in preventing labour markets from clearing has received more attention. In a seminal article appearing in 1981 McDonald and Solow proved that a union facing a downward shift of the labour demand curve, which does not change the real wage elasticity of employment, would have no incentive to lower real wages to absorb the fall in employment. A rigid real wage would be even more likely if the union only cared about its employed members [the "insiders", see Lindbeck and Snower (1986a and b)]. Indeed, with this addition the union hypothesis can explain several phenomena currently observed. Thus real wages will not only tend to be higher and more rigid in unionised than in non-unionised sectors, but unions attempting to maximise income for their employed members would also create hysteresis in the natural rate of unemployment [see Blanchard and Summers (1986) and the discussion in Section IV below]. Moreover, the influence of unions may go some way towards explaining the flexibility of real wages and the favourable employment development in the US services sectors compared with manufacturing [Gordon (1987a)] as well as the different employment performances in the United States and in Europe, since the European services sectors tend to be more highly unionised and/or adopt the wage levels of the manufacturing sectors [see Burda and Sachs (1987) on employment in the German services sectors]. Finally, policies in some countries (especially the United Kingdom and the United States) have been based on the assumption that by reducing the power

of unions real wage flexibility would increase and employment prospects improve. On the other hand, while the union wage theory may explain why real wages have been more rigid and unemployment persistently higher in Europe than in the United States, it does not explain why the rise in unemployment has been so general in Central Europe, nor why some of the Nordic countries (where the share of the unionised labour force is very high) have managed to keep unemployment low.

Efficiency wage theory. While the implicit contract theory means that adult workers receive a real wage which is *below* their marginal productivity the efficiency wage theory leads to a real wage level which is *higher* than labour's marginal productivity and therefore also higher than the rate at which labour markets would clear. The basic assumption underlying this hypothesis [Solow (1979b)] is that labour efficiency increases with the real wage due to greater effort, less shirking and lower turnover. Moreover, training costs would fall, since firms offering a higher wage are able to attract more highly trained workers. When the rise in efficiency takes place at a decreasing rate there is one real wage level at which firms maximise their profits regardless of the cyclical position.[46] Hence they have no incentive to lower real wages in the face of an adverse demand shock but prefer to reduce employment. In one version of the hypothesis [Shapiro and Stiglitz (1984)], labour efficiency also depends (positively) on the rate of unemployment, generating a pro-cyclical pattern of real wage changes. In another version [Summers (1988)] efficiency depends on the real wage of one firm relative to those paid by competitors. This wage-wage link does not affect the cyclical sensitivity of real wages but tends to lengthen the lags of the wage

[46] For proof see Blanchard (1987b), p. 43. Because of the relationship between productivity and the real wage q(W/P) the firm has two decision variables: the real wage and employment. The former is chosen strictly on the basis of q(W/P) and independently of the cyclical situation. With W/P given, the firm then proceeds to hire the desired number of employees.

adjustment process.[47] Although the efficiency wage hypothesis is still in its infancy [see the survey by Katz (1986)], it appears to provide a solid theoretical foundation to the phenomenon of non-clearing labour markets. The main problem is really at the empirical level, as the efficiency wage theory entails largely the same predictions as the union-based theory and from existing data it is difficult to say whether relatively rigid wages are caused by income-maximising unions or profit-maximising firms (or both).[48]

Staggered contract theory. Another theory of recent vintage which attempts to explain lags in the adjustment of wages but has implications for their cyclical sensitivity as well is the staggered contract theory.[49] Based on the phenomenon of three-year overlapping contracts in the unionised sectors of the United States, unions negotiating in a certain year will take account of settlements obtained by other unions in the previous two years and of those likely to be reached in the forthcoming two years. By also assuming that wage claims are influenced by expected price changes, this hypothesis generates a long and complex lag structure in prices and wages. At the

[47] The question of whether workers' wage claims are based on relative or real wage targets has occupied economists for many years and is still an unsettled issue. Keynes (1935) argued that workers are mainly concerned about their relative wage and this view is supported among others by Okun, Tobin, Phelps and Bosworth. Friedman's version of the NRH as well as the New Classical Model focuses on real wages, and this is also the case in several models of the New Keynesian School. In theory, wage-wage links increase the adjustment lags of the wage-price mechanism but empirically it is virtually impossible to identify the separate influence of real and relative wage targets.

[48] Summers (1988) argues that the two theories complement each other as firms paying an efficiency premium are unlikely to resist union wage claims. This, however, still leaves the separate contributions of unions and firms to rigidities undetermined.

[49] The concept of staggered contracts was first analysed in Fischer (1977a) and Taylor (1980). Both models combine rational expectations with non-clearing wages and prices but differ in other respects. Fischer assumes that firms are price-takers and that the real wage at the beginning of a period is set at the market-clearing level but fails to adjust to shocks during the period. In Taylor's model firms set prices as a mark-up on wage costs while wage earners are concerned about their relative income position. This creates a wage-wage link and much longer lags than in the Fischer model.

same time, since only one-third of the unionised labour force negotiates each year, current labour market conditions will have only a small effect on current aggregate wage changes. From an analytical point of view this theory provides an elegant explanation of wage rigidities, and it was also the first to incorporate rational expectations into a Keynesian model. Yet, even though it is founded on institutional factors, it may be questioned on empirical grounds. Thus in the United States the share of the unionised labour force is only 20% and falling and in the non-unionised sectors negotiations are annual. Moreover, the phenomenon of multi-year staggered contracts is virtually absent outside North America. For instance, in the Nordic countries wage contracts usually cover more than one year, but the negotiations are centralised or simultaneous. In Germany, France, Belgium, Austria, the Netherlands, Switzerland and the United Kingdom most wage agreements are annual, and this also applies to Japan. In Italy wage agreements are sectoral and tend to cover several years but the degree of staggering is small. Finally, in Australia and New Zealand wage negotiations take place within an institutional framework which is different from those of most other countries but actually attempts to reduce the degree of staggering.

(iii) Theories of Nominal and Real Price Rigidities.

Customer markets. Turning then to output markets and the explanations of sluggish price adjustments, a basic assumption of virtually all New Keynesian Models is that price and output decisions are made under monopolistic or oligopolistic conditions where each firm, because of location, product or size characteristics faces a non-horizontal demand curve and has some power to set its own price.[50] Okun (1975 and 1981) named such markets customer markets

[50] Note, however, that imperfect competition alone does not lead to price rigidities. Ceteris paribus, it only implies that the level of prices is higher than under perfect competition. The same applies to unions. It has long been recognised that unionised workers receive higher wages than non-unionised workers, but not until the McDonald and Solow article was it fully appreciated why and how unions affect the flexibility of labour markets.

(as distinct from auction markets where perfect competition prevails)[51] and argued that because of the close relationship between sellers and buyers firms hesitate to change prices in response to cyclical fluctuations, whereas price changes justified by cost movements would be accepted as "fair" by the buyers. At the same time, because of the costs incurred in obtaining information from other firms, buyers would be reluctant to leave a seller once a relationship had been established. One weakness of this hypothesis is that "fairness" is difficult to use in behavioural equations. Moreover, long associations between buyers and sellers do not always produce the outcome predicted by Okun. For instance, in an analysis of US transaction prices for intermediate goods, Carlton (1986) finds that the degree of price rigidity is highest for buyer-seller associations of short length and he ascribes this to mutual distrust. He further finds that in associations of short duration the price changes tend to be much larger than in cases of low rigidity and long buyer-seller associations.

Cumulation hypothesis or input-output approach. While the customer market model attempts to explain the cyclical insensitivity of profit margins (real rigidities) the cumulation hypothesis focuses on the lags observed in aggregate price equations (nominal rigidities). The model does not introduce any new theories on price-setting behaviour but explains the lags by the interactions between firms within a large input-output framework. Using monthly data for the United States, Blanchard (1987a) provides evidence that for price indices at high levels of aggregation (such as final output prices or the

[51] Hicks (1975) introduced a similar distinction by referring to "fix and flex" price markets. A rigorous theoretical model of monopolistic competition was presented by Phelps and Winter (1970) and has provided the analytical underpinning to many recent empirical models of pricing behaviour. Bosworth (1980) explores the appropriate policy response in conditions where a price shock occurs in the auction market while the main response to changes in policies and aggregate demand is to be found in customer markets. However, subsequent events (i.e. the fall in oil and non-oil commodity prices since 1985) have shown that restrictive policies can have a substantial price dampening effect in auction markets as well.

GDP deflator) the lags are of about the same length as for wages, whereas for indices at low levels of aggregation lags are virtually absent. This discrepancy may be explained as the cumulation of short lags when outputs of firms at one production stage are sold as inputs to firms at a higher stage (vertical interaction) or to firms at the same stage (horizontal interaction). According to Gordon (1987c), the input-output framework can also explain why output prices do not fully absorb a change in aggregate nominal demand (see equation (iv'), p. 38). Thus to a single firm placed somewhere in the input-output structure the key concern in setting the output price is the expected development in its own costs. For most firms these are only remotely related to aggregate demand, whereby the condition for short-run money neutrality is broken. In other words, when the benefits of a complete absorption of the aggregate demand change through prices are entirely external, no individual firm would be induced to link its price to aggregate nominal demand.[52]

Excess capacity. The importance of excess capacity has been stressed by Hall (1986)[53] who, using industry data, finds that firms' mark-up on marginal costs is well above unity, as would be implied by any market constellation other than perfect competition. Subsequently, however, Hall finds that profits are not particularly high and well below the level expected for production at the point where average costs attain a minimum. This is ascribed to the fact that many monopolistic firms are too small to utilise their physical plants and equipment fully, so that they produce at the downward-sloping part of their average cost curve or at best where the marginal

[52] As shown by Hart (1982), a firm faced with a shift in its demand curve has no incentive to change its price if the shift affects neither the elasticity of demand nor the marginal cost curve (see also p. 41 and the section below). Moreover, the point of optimal output would only remain unchanged if the marginal revenue and cost curves shifted by the same amount. Since marginal costs depend on firm or sector-specific labour costs and other inputs may be imported, such parallel shifts are unlikely. For further discussion see Gordon (1981).

[53] The model is further developed in Hall (1988). Lipsey (1981) presents similar arguments in characterising the inflation process in industrial countries.

cost curve is very flat. Consequently, firms have little incentive to raise prices in the event of a rise in nominal demand (or to lower prices in the event of a decline), as their average costs are likely to be lower, or at worst constant, at higher output levels; and for the same reason changes in money supply and nominal demand are bound to have real effects. At first glance, this appears to refute the natural rate hypothesis. However, since the firms in the sample have on average produced at a sub-optimal level of output, Hall's empirical results do not tell us anything about firms' pricing behaviour once they attain equilibrium. In some sense the results merely restate the well-known fact that the aggregate supply curve is fairly flat below full capacity, with the addition that output in that range of the curve is far more common than generally assumed.

Menu costs. A whole range of recent pricing models are based on the notion that prices are subject to adjustment or menu costs [see the survey by Rotemberg (1987)]. This in turn implies that prices will only be adjusted at certain time intervals and/or that a certain threshold has to be exceeded before demand and cost changes have any effect. One well-known model based on the notion of a threshold is the sS-model first introduced as a pricing rule by Barro (1972). According to this model, firms adjust prices by S% whenever the difference between the actual and optimal price exceeds s%. If all firms have the same sS rule and are uniformly distributed with respect to their last price change, a constant rate of money supply growth will be accompanied by a price change of the same rate [Blanchard (1987b) and Rotemberg (1987)] while real output is constant. Hence, for this special case prices at the firm level are rigid, while the aggregate price index is flexible. In another model [Rotemberg (1987)] the cost of changing prices is assumed to depend on the size of the price change rather than being constant. Under certain conditions this leads to a pricing rule whereby current price changes are a weighted average of current money supply changes and lagged price changes. This is easy to estimate – and seems to hold for both US and German prices – but the underlying assumption of price-dependent costs does not seem very plausible.

Research in this particular area has been prolific but is still in its infancy and at this stage it is hard to say to what extent existing rigidities can be ascribed to adjustment costs. One important point, however, is that, even though menu costs are of second-order importance to individual firms, their macroeconomic effects may be of first order [see Ball et al. (1988) and Blanchard and Kiyotaki (1987)] owing to an aggregate demand externality. As an illustration, let demand for the product of firm i depend on its relative price (P_i/P) and aggregate demand be determined by the real money stock (M/P). A fall in M will now shift the demand curve to the left and in the absence of menu costs firm i could increase its profits by lowering its relative price. If all firms did that, P would decline and M/P quickly return to its initial level. However, when menu costs are present it does not pay for an individual firm to adjust its relative price, P remains constant and the fall in M leads to a fall in real output. This externality is very similar to that implied by the cumulation hypothesis in that the aggregate effects of what appears to be small deviations from optimal behaviour are large. Furthermore, the lags in aggregate prices implied by menu costs will be even longer if firms' price adjustments are staggered rather than simultaneous and/or when prices are more sensitive to increases than to declines in aggregate demand.[54]

(iv) Concluding Remarks.

There are several theories providing a firm underpinning to sluggish wage adjustments and lagged price adjustments are also well explained.[55] However, the likely cyclical pattern of prices is still not

[54] This asymmetry would also lend an inflationary bias to the economy [Tobin (1980)] but with few exceptions [Kuran (1983)] most empirical studies find no evidence of asymmetric price adjustments.

[55] In this context it is also worth noting the proposition in Laidler (1984) that the existence of buffer stock holdings of money justifies sluggish price adjustments as the buffer stock removes a need to change prices immediately in line with market developments.

very satisfactorily explored.[56] While in raw material markets prices respond quickly to changes in demand and supply, very little is known about price formation in the services sectors.[57] For the typical manufacturing firm, the results reported in a recent survey of Swedish firms [see Faxén et al. (1988)] are typical of firms in many other countries as well:

- because of transaction costs, long-term customer contracts and low price sensitivity among customers, prices tend to be less flexible than wages and to be adjusted at most twice a year;
- influenced by discount systems and falling average cost curves, prices also tend to move counter-cyclically.

However, the theories explaining this behaviour of firms as well as that of their customers are still not very well developed, and as we shall see below this "gap" in the theory is matched by a "gap" in the empirical evidence.

III. Empirical Evidence on Rigidities

(a) Single Equation Estimates. Although the wage and price equations are equally important in evaluating the relationship between nominal and real variables, a disproportionately large part of both the theoretical and empirical literature has been devoted to the wage equation.[58] Most empirical studies come to the conclusion

[56] In fact, many recent pricing models used for empirical work rely on the Cournot rule that the optimal price for a profit-maximising firm facing a downward-sloping demand curve with elasticity e is MC e/(e−1), where MC is marginal costs. Consequently, the cyclical pattern of price changes depends on the cyclical pattern of e, which is a priori unknown.

[57] See, however, Rappoport (1987), who finds that the differential change in the deflators for the US services sectors and manufacturing is mainly the result of energy price and unit labour cost developments in the two sectors, whereas, for instance, general demand and exchange rate movements have very little influence.

[58] Gordon (1988a) redresses the balance by raising the possibility that "the 'wage equation', the traditional centerpiece of the aggregate supply sector of large-scale econometric models, may be redundant, misleading or irrelevant", and subsequently finding his suspicion confirmed by US data.

that in virtually all countries prices are fully reflected in wages, though the response is subject to lags. Most studies [see, for instance, Grubb et al. (1983)] also tend to find that the lags are longer (i.e. the degree of nominal rigidity higher) in the United States than in most other countries and ascribe this to the prevalence of three-year contracts in the unionised sector and to the less frequent use of wage indexation with lower compensation ratios than, for instance, in Europe. However, for the remaining parameters of the wage equation it is difficult to find a consensus. Relatively few studies have tested the sensitivity of wages to productivity and when they do the results are mixed. Moreover, as can be seen from Table 4, the estimated coefficients with respect to the rate of unemployment (i.e. the real rigidities) cover a very wide range and are very sensitive to the periods of estimation, specifications and definitions of the variables used.

The variation in real wage flexibilities across countries has been the object of numerous studies and some authors [see, for instance, Bruno and Sachs (1985) and Newell and Symons (1987)] have explained the degree of real wage flexibility by the "degree of corporatism", assuming (and finding) a positive relationship across countries. Corporatism is, however, difficult to quantify, though one indicator used is the degree of centralisation in wage negotiations. In a recent and interesting contribution Calmfors and Driffill (1988) have questioned this use, arguing that the relationship between real wage rigidities and the degree of centralisation is not monotone, as assumed by the 'corporatists', but 'hump-shaped'. For negotiations at the firm level (as, for instance, in North America) the labour demand curve tends to be rather flat, thus reducing the monopoly power of unions and the level of real wages bargained for. For centralised negotiations (typical for the Scandinavian countries) the labour demand curve will be much steeper. However, because increases in aggregate wages are bound to affect prices as well, the real gains obtained will be rather small, thus again introducing a certain degree of moderation on the part of unions. For negotiations at intermediate stages of aggregation (sectors or industries), which is

Table 4
Real Wage Rigidities[1]

Countries \ Authors	Coe (1985)	Grubb et al. (1983)	Grubb (1986)	Knoester and van der Windt (1987)	Bean et al. (1986)	Newell and Symons (1985)	Newell and Symons (1986)	Gordon (1987b)[2] U	Gordon (1987b)[2] Q/Q*	Author's estimates	Average
United States	−0.66	−0.24	−0.94	−0.05	−0.05	−0.11	−0.38	−1.43	0.55	−0.31	−0.34
Japan	−6.62	−8.09	−4.13	−1.82	−24.1	−3.22	−5.42	+0.12	0.28	−2.75	−7.02
Germany	−0.56	−0.72	−1.06	+1.24	−1.15	−0.36	−0.66	−0.48	0.29	−2.20	−0.68
France	−0.62	−1.69	−1.82	+0.03	−0.55	n.a.	−0.16	−2.02	0.46	−0.44	−0.65
United Kingdom	−0.34	−0.42	−1.15	n.a.	−0.16	−0.03	−0.06	−1.06	0.50	−0.75	−0.42
Italy	−1.30	−0.88	−0.34	−1.00	+0.00	−1.28	+0.12	−2.52	0.77	−0.91	−0.70
Canada	−0.94	−0.64	−0.93	−0.02	−0.13	−0.33	−0.44	−1.57	0.50	−0.23	−0.46
Australia	−0.96	−0.89	−1.46	−0.14	−0.69	n.a.	−0.49	n.a.	n.a.	−0.85	−0.81
Austria	−1.08	−3.19	−1.08	n.a.	−5.10	−0.80	−2.00	−1.90	0.51	−4.81	−2.61
Belgium	n.a.	−1.25	−0.99	n.a.	−0.57	−0.27	−1.11	−0.63	0.58	−0.25	−0.74
Denmark	n.a.	−0.52	−0.83	n.a.	−0.12	n.a.	n.a.	−0.59	0.27	−0.33	−0.45
Netherlands	−0.82	−1.95	−2.65	−0.08	−0.25	−0.78	−0.33	−0.27	0.04	−0.50	−0.92
Sweden	n.a.	−2.45	−3.63	−2.19	−3.88	−1.36	−0.27	−0.41	0.61	−2.73	−2.35
Switzerland	n.a.	−7.14	−6.50	n.a.	−23.3	−3.15	−3.61	−6.33	0.67	−4.77	−7.83
Average	−1.33	−2.15	−1.96	−0.45	−4.29	−1.06	−1.14	−1.47	0.46	−1.56	−1.85

[1] In order to obtain comparable figures, the estimated and reported coefficients were divided by the average unemployment rate for the period 1960–86 (U) when U was specified as log U, and by (U^2) when U was measured by 1/U. Moreover, those shown in Coe (1985) were multiplied by 2. The coefficients can be interpreted as semi-elasticities; i.e. the percentage point change in nominal wage inflation for each 1 point change in the rate of unemployment. [2] The first column shows the elasticity of nominal wages with respect to U and the second column (not included in the averages) the elasticity with respect to the ratio of actual to trend output.

the bargaining structure found in, for instance, Germany, France, Italy and the United Kingdom, the labour demand curve will be far less elastic than at the firm level while the probability of wage increases affecting consumer prices is smaller than for centralised negotiations. Consequently, according to Calmfors and Driffill, unions in these countries are likely to be more aggressive and the degree of real wage rigidity correspondingly higher.

Whatever the explanation, the country averages in the last column of Table 4 suggest that real wage flexibility is highest in Japan, Austria, Sweden and Switzerland and lowest in North America and the United Kingdom. However, for the former group of countries the estimated coefficients may be influenced by the low average values for U. Moreover, in all four cases U may not be the best indicator of

labour market imbalances due to large cyclical variations in average hours worked and in participation rates and to special policy measures. In this respect the estimates provided by Gordon (column Q/Q*) may be more comparable across countries, and according to this indicator real wage flexibility is not particularly low in North America and the United Kingdom, nor particularly high in Japan. Sweden and Switzerland, on the other hand, continue to show a high degree of flexibility.

As regards the price equation, Nordhaus (1972) in a survey paper presented to a Federal Reserve Board Conference on price equations mentioned five major shortcomings:

- most specifications and interpretations have proceeded without the benefit of formal theory;
- very little is known about the structure of the impact of demand on prices;
- authors have been quite casual about whether they measure prices in levels or in first differences;
- in most studies very little attention has been given to the structure of errors;
- most authors estimate prices as a mark-up on unit labour costs and very few include other costs, such as capital costs and/or raw material prices.

Even though this was written more than fifteen years ago, the shortcomings are still found in most empirical studies of prices. The principal problem remains the weak evidence on the cyclical sensitivity of prices,[59] and this appears to be linked to the third problem since the coefficients obtained depend crucially on whether economic slack is assumed to affect the *level* of prices or their *rate of change*. As can be seen from Table 5 on p. 54, prices tend to follow a pro-cyclical pattern when the equation is specified in levels,[60] whereas

[59] In the United States there has been a long and extensive debate as to whether prices have become less cyclically sensitive over time. Although this issue is clearly related to that of real rigidities the debate seems to have proceeded more or less on its own and ended in a "draw".

the price equation estimated in first differences suggests that higher demand dampens the rate of inflation.[61] The problem, however, is not merely one of finding a satisfactory measure of real price rigidities but concerns the appropriate modelling of long-run equilibrium relationships. The level formulation (see footnotes to Table 5) rests on the assumption that the *level* of long-run output prices cannot deviate too far from a weighted average of costs and external prices, whereas the first-difference equations merely require their *rates of change* to be largely equal. For most countries the equations reported in Table 5 favour the level formulation, which, as noted, also generates a pro-cyclical profit mark-up. However, it should be emphasised that econometric tests in this area are still evolving and preclude definite conclusions.

Another unresolved issue concerns the cost components to be included in the price equations. While the 1972–73 rise in oil and non-oil material prices led to the inclusion of export and import prices in equations for final demand or output deflators, very few studies include measures of capital costs. Possibly as a result of this, it is quite common to find that the coefficients on the cost components do not add up to unity, suggesting that the mark-up is less than 100%.[62] The structure of errors or lags in the price equations

[60] An exception to this is Bils (1987) who estimates the cyclical sensitivity of output prices and marginal costs respectively, using changes in employment as an indicator of the cycle. For US manufacturing he finds that a 10% rise in employment is normally accompanied by a 2.4% increase in marginal costs but a 0.9% fall in prices, thus yielding a decline in the mark-up of 3.3%.

[61] Gordon ascribes this to the influence of spreading fixed costs over a larger volume. The estimated cyclical sensitivity of prices also depends on whether unit labour costs are measured using actual or trend productivity. For the United States most authors prefer trend productivity, while for other countries the evidence is mixed.

[62] Again the results depend on the specification of the price equation. For the first two studies cited in Table 5 the long-run coefficients satisfy the homogeneity condition (i.e. the sum of the cost coefficients is approximately unity), whereas for the equations specified in first differences the sum of the coefficients is less than unity. However, a large and positive intercept term is usually found, pointing to a trend rise in prices independently of costs and cyclical developments.

Table 5
Cyclical Sensitivity of Prices

Countries	Author's estimates[1]		Stiehler (1987)[2]		Gordon (1987b)[3]	
	short run	long run	long run	(average lag in year)	Price equation	Reduced form
United States	0.51	0.82	0.57	(2.9)	−0.15	0.33
Japan	0.10	0.46	0.29	(4.2)	0.22	0.32
Germany	−0.05	−0.17	0.19	(1.5)	−0.27	0.27
France	0.13	0.72	0.42	(3.8)	−0.09	0.44
United Kingdom ..	0.16	0.20	0.54	(4.8)	−0.05	0.95
Italy	0.26	0.50	0.39	(1.3)	−0.26	0.75
Canada.....	0.03	0.07	0.36	(2.6)	−0.05	0.51
Australia	0.25	0.71	n.a.	n.a.	n.a.	n.a.
Austria.....	0.28	n.d.	n.a.	n.a.	−0.38	0.33
Belgium	0.24	0.60	n.a.	n.a.	−0.40	−0.05
Denmark	0.34	0.77	n.a.	n.a.	−0.47	0.41
Netherlands.....	0.11	0.30	n.a.	n.a.	−0.30	0.21
Sweden.....	0.32	0.61	n.a.	n.a.	−0.02	0.93
Switzerland	−0.01	−0.04	n.a.	n.a.	0.09	0.07

[1] Estimated equation is:

$dp_t = a + bQ_t/Q^* + cdulc_t + edpx_t + fdxr_t + g(ulc-p)_{t-1} + h(px-p)_{t-1} + ixr_{t-1} + jp_{t-1}$

with p = GDP deflator in factor prices, Q_t/Q^* = actual to trend output, ulc = unit labour costs, px = export price deflator, xr = effective exchange rate. The short-run coefficient is b and refers to the influence of Q_t/Q^* on the rate of inflation. The long-run coefficient is calculated as b/(h + g−j) and refers to the influence of Q_t/Q^* on p.

[2] Specification similar to that above except that p_{t-1} is dropped and xr replaced by the terms of trade. Moreover, p refers to the gross output deflator of the private non-energy sector.

[3] Price equation estimated is:

$dp_t = a + bQ_t/Q^* + cdulc_t + ed(pm-p)_t$

The reduced form is obtained by inserting the wage equation for dw so that the coefficient indicates the cyclical sensitivity of wages as well as prices.

are also issues on which little progress has been made since Nordhaus' review and there are virtually no systematic and comparable studies of lags in wage and price equations.[63] At the same time, the first short-coming mentioned by Nordhaus is no longer a valid criticism. Indeed, as discussed above, recent years have seen a large number of

[63] Blanchard (1987a) is a notable exception in this respect. Using monthly data, he finds that price adjustments in the United States are subject to the same or slightly longer lags than wage adjustments.

new hypotheses on price formation with accompanying empirical estimates. Today the problem appears to be rather that there are too many hypotheses to choose from and that the most appropriate one cannot be identified on the basis of existing data.

(b) Reduced Forms and Model Simulations. The last column of Table 5 provides a measure of the combined cyclical sensitivity of wages and prices. According to this indicator the wage-price mechanism is particularly flexible in the United Kingdom and Sweden and rigid in Belgium and Switzerland. The three largest countries are all in an intermediate group where a 1 point change in actual relative to potential output changes the rate of inflation by 1/4–1/3 of a point. It should be stressed that these measures refer to the very short run as for all the countries in the table the underlying model assumes the absence of a long-run trade-off.

A different kind of reduced-form parameter is given in Table 6 on p. 56, which shows correlations between the level (W/P) or the change (d(W/P)) of real wages and a cyclical indicator, measured by either the rate of unemployment (U) or the ratio of actual to trend output (Q/Q*). From the elasticities shown in Table 4 and the coefficients from Gordon's price equations in Table 5, *changes* in real wages should be negatively correlated with unemployment and, as can be seen from the first column, this is the case for all countries. Moreover, the correlation is particularly high for the continental European countries and Japan, but low in all the Anglo-Saxon countries. The earlier results would also suggest a positive relation between d(W/P) and Q/Q*, but this is less well supported (column 2), especially (but not only) for countries with a low correlation in the first column.

The last two columns are more difficult to interpret. The correlation between W/P and Q/Q* is positive for twelve of the countries but in most cases not very significant, suggesting that the *level* of real wages is insensitive to cyclical changes. By contrast, for all countries there is a positive and significant (except for the United States and Austria) correlation between W/P and U, thus reversing

Table 6
Cyclical Pattern of Real Wages
(Simple correlation coefficients, annual data 1960–86)

Countries	First difference (d(W/P))		Level (W/P)	
	U	Q/Q*	U	Q/Q*
United States	−0.33	−0.14	0.31	0.43
Japan	−0.72	0.47	0.78	0.15
Germany	−0.87	0.79	0.88	−0.40
France	−0.68	0.58	0.97	0.03
United Kingdom	−0.32	0.08	0.89	0.13
Italy	−0.80	0.21	0.81	0.26
Canada	−0.32	−0.09	0.74	0.26
Austria	−0.55	0.21	0.23	0.25
Australia	−0.31	0.53	0.89	0.12
Belgium	−0.63	0.59	0.89	0.15
Denmark	−0.50	0.12	0.67	0.25
Netherlands	−0.88	0.32	0.86	0.34
Sweden	−0.61	−0.06	0.59	0.41
Switzerland	−0.49	0.66	0.74	−0.04

the signs found for d(W/P).[64] This could imply that the level of prices is more cyclical than the level of wages. However, it could also mean that we are looking at a different chain of causality, as the rate of unemployment tends to increase when the level of real wages is excessive. Whatever the interpretation, the table amply illustrates why the cyclical sensitivity of real wages has been a "hot issue" ever since Keynes' General Theory (see note 17 on p. 19).

While the reduced-form coefficients are more satisfactory than the flexibility measures based on the wage or price equations alone, they are still only partial indicators since other relations may also influence the extent and speed with which inflation responds to

[64] This sign change has also been found in other studies. For instance, Fair (1984) estimates wage and price equations for the United States with levels and first differences respectively as functions of unemployment. By simulating the models he subsequently finds that *changes* in real wages (d(W/P)) are strongly pro-cyclical, whereas the *level* of real wages (W/P) follows a slightly counter-cyclical pattern.

changes in aggregate demand and other shocks.[65] The only way to derive a more comprehensive measure is through simulations of large models, and the results obtained when subjecting six models of project LINK to an aggregate demand shock (more expansionary fiscal policy) and a supply shock (higher oil prices) respectively are presented in Table 7 on p. 58. The figures refer to changes over three years (compared with a baseline solution) and starting with the fiscal shock, it is seen that the rise in US wage inflation is relatively low, particularly considering the large drop in unemployment. Moreover, the price response parallels the wage response, so that the levels of real earnings and real labour costs remain largely unchanged. By contrast, in the United Kingdom and Japan nominal wages accelerate sharply. In the case of Japan, this confirms the very high real wage flexibility observed in Table 4, and for the United Kingdom it reflects the joint effect of a sharp fall in U and a real wage flexibility which is higher than in most other studies. Moreover, since prices are rather insensitive to aggregate demand (or subject to very long lags) the levels of real earnings and real labour costs rise sharply. Germany and Canada occupy intermediate positions while in France real earnings and wage costs appear to be as stable as for the United States.

However, as can be seen from the right-hand side of the table, this similarity between the United States and France is deceptive, thus illustrating the aforementioned dependence of flexibility measures on the type of shocks experienced. Because of a large import share for oil and a high degree of de facto wage indexation, consumer prices and nominal wages accelerate sharply in France and, since firms appear to be constrained in raising their output prices, real wage costs increase sharply as well. A large rise in real labour costs is also observed for Japan, even though the response of nominal wages is moderate. The

[65] The labour demand equation is particularly important in this respect as a quick response of labour demand to real wages and output may more or less offset a sluggish cyclical response of wages and prices and ensure a quicker adjustment path.

Table 7
Model Simulations

Countries	Fiscal shock					Supply shock				
	U	dPC	dW	W/PC	W/P	U	dPC	dW	W/PC	W/P
United States ...	−0.7	0.5	0.5	0.0	0.0	0.9	0.1	0.1	−0.2	0.2
Japan	−0.1	0.5	1.2	1.8	1.5	0.0	0.1	0.1	−0.1	1.1
Germany	−0.5	0.3	0.7	0.8	0.5	0.5	0.4	0.3	−0.4	0.1
France	−0.2	0.5	0.6	0.1	0.0	−0.1	1.7	1.8	−0.2	1.3
United Kingdom	−0.8	0.4	1.3	1.2	1.2	0.1	0.7	0.2	−0.7	−0.5
Canada.....	−0.4	0.3	0.6	0.6	0.2	0.1	0.1	0.1	−0.1	0.2

Notation: U = rate of unemployment, dPC = percentage change in consumer prices, dW = percentage change in nominal wages, W/PC = level of real earnings and W/P = level of real labour costs.
Source: Hickman and Klein (1984).

most striking feature of this simulation is probably the result obtained for Germany. Contrary to the popular view that the rise in unemployment has been due to rigid real wages, the simulations show a decline of real earnings and the rise in real labour costs is very small. In fact, only the United Kingdom has a more favourable outcome in this respect, but this is largely the result of oil prices being included in the GDP deflator and does not imply that real wages have been particularly flexible. Finally, for the United States the simulations confirm the stability of real wages noted earlier, but it is also worth noting that this is not solely the result of moderate wage behaviour, as the United States has the largest rise in unemployment of the countries shown in the table. Indeed, the large sensitivity of US employment to both demand and supply shocks is another striking feature of the simulations and has been confirmed in other empirical studies [see Newell and Symons (1985)]. It suggests, however, that the main difference between the United States and Europe is perhaps to be found not in the parameters of the wage and price equations but in the labour demand function.

(c) Reliability of Empirical Estimates. The parameters and simulations discussed above should be viewed with caution. Numerous studies show that even for the same time period a slight change in specification can lead to entirely different conclusions

concerning the degree of rigidity or flexibility.[66] Moreover, parameters do not stay constant over time and when they change it may be difficult to identify the causes precisely. This is particularly important to policy-makers, as the appropriate policy response is crucially dependent on the source of a given change in behaviour. As an illustration consider recent developments in nominal wages in Europe, which, according to Coe et al. (1988), have increased faster than predicted by earlier equations. Several factors may have caused this apparent change in behaviour:

– a rise in the degree of real wage rigidity, because wage changes become less responsive when the rate of unemployment is very high;[67]

– a rise in the degree of nominal rigidity, reflecting an asymmetric response to positive and negative changes in consumer prices or the existence of an "inflation floor" as wage earners consider low (or negative) changes in consumer prices to be unsustainable or inconsistent with current monetary policies;

– a rise in the natural rate of unemployment owing to either hysteresis or structural changes in the labour market;

– the influence of factors which have not been included in the earlier specification, such as real wage targets and related catch-up attempts on the part of wage earners.

In the first two cases a further tightening of policies would yield only a small or no further decline in the rate of inflation, while a relaxation of policies would be accompanied by only a small or no increase in inflation. By contrast, if the natural rate of unemployment has increased, a tightening of policies is needed to prevent inflation from accelerating further or, at best, the room for policy measures is smaller than previously thought. Finally, if the missing variable is a real wage target, the excess nominal wage rise would remain as long as the target has not been achieved and the rate of unemployment stays at its current level. Unfortunately, with usually less than ten observations available, it is difficult to identify

[66] See Kahn (1984) and Schultze (1984), to mention just two examples.

[67] See also the discussion on p. 30.

behavioural changes with any statistical certainty. This, in turn, implies that until firmer evidence becomes available policy-makers will be "working in the dark".

An issue of perhaps even greater interest to policy-makers is the influence of policy changes (or regime shifts) themselves on behavioural parameters in general and on the wage-price mechanism in particular. Sargent (1982) presents evidence that in four hyper-inflation countries in the 1920s credible anti-inflation programmes substantially reduced or removed inflation with little output loss as expectations and parameters changed in line with policy announcements. However, recent examples are more difficult to find. For instance, the move to flexible exchange rates in the early 1970s could have been expected to increase the speed with which monetary policy changes are reflected in the rate of inflation, as import and export prices are no longer exogenous and exchange rates may actually change ahead of any change in output markets. However, while there is plenty of evidence that exchange markets have become more volatile and are sensitive to policy changes there is little evidence that the lags in the wage and price functions have become appreciably shorter.

Similarly, the introduction of money aggregate targets in the early 1970s and especially the shift to reserve targeting in the United States in 1979 could have been expected to affect behavioural parameters, in particular through the formation of price expectations. Again, there is clear evidence that financial markets have become more volatile and sensitive, but there is little firm evidence of any change in the wage-price mechanism.[68] Perhaps the number of observations is still

[68] See Englander and Los (1983), Taylor (1984), Blanchard (1984), Perry (1983), Cagan and Fellner (1983) and Friedman (1988) with respect to the US experience. Christensen (1987) has tested whether the regime shift in Denmark in 1982 was accompanied by any parameter changes. He concludes that, apart from the parameters of the interest rate equation, behavioural relations remained stable, even though abolition of wage indexation (in effect for more than 60 years) was an important part of the policy change.

too small to identify parameter changes with the required degree of precision. It is also possible [Mishkin (1984)] that this episode is not a valid test of the credibility hypothesis or the Lucas critique (see note 25, p. 25) since, in view of the very expansionary fiscal policy, the shift from interest rate targeting to reserve targeting was not a significant change in the anti-inflationary policy regime.

Chan-Lee et al. (1987) have subjected wage and price equations for all industrial countries to various statistical tests in order to identify possible parameter changes. However, apart from the United States and the United Kingdom, the parameters appear to have been stable, which leads the authors to conclude that (p. 146):

> "the wage disinflation of the 1980s can largely be understood in terms of declines in inflation (related to developments in commodity price, exchange rates, etc.) and increases in unemployment."

IV. The European Phillips Curve

As mentioned several times in the previous sections, the recent path of inflation and unemployment in Europe does not seem compatible with the NRH. Restrictive policies were adopted in 1979–80 and have brought the average rate of inflation in EEC countries down from almost 12 to less than 4%. However, unlike in the United States, the rate of unemployment has not returned to its initial level; nor has the rate of inflation continued to decelerate, as the NRH would imply. Consequently, one is left with the impression that Europe still fits the old Keynesian model with a permanent long-run trade-off.

It would go far beyond the scope of this paper to attempt even a superficial review of all the recent studies of the European unemployment problem.[69] Instead, the discussion will be confined to

[69] See for instance Sachs (1986), Lawrence and Schultze (1987), Fitoussi and Phelps (1988), Beckerman (1986) and *Economica* (1986), Special Issue.

the European Phillips curve and to the various hypotheses concerning its particular shape. More specifically, the following sections attempt to answer the question of whether the European model is different from the NRH or whether certain changes to key variables and parameters have distorted the underlying relationship.

(a) Continuous Rise in the Natural Rate.

Virtually all studies of the European scene have come to the conclusion that the NAIRU or the natural rate has increased so that the observed changes in inflation and unemployment combine movements along a given Phillips curve with shifts of the curve towards the right. This further implies that the scope for a non-inflationary expansion of demand is narrower than models with a constant U* would predict and that at current rates of unemployment there is relatively little downward pressure on wage and price changes. A key question is, however, why the European U* should have increased when in the United States it now appears to be lower than in the 1970s. Moreover, even accepting that an increase has taken place, there remains the problem of determining the existing degree of slack.[70]

(i) Structural Rigidities. One reason for the rise in U* might be a gradual increase in labour market rigidities. However, while there is little doubt that European labour markets are less flexible than the US market, there is no evidence that markets have become more rigid during the 1980s. In fact, several countries have taken steps to reduce rigidities by tightening the rules on unemployment benefits, curtailing the power of unions, increasing the scope for part-time and temporary work and reducing the burden of employment taxes paid by firms. Moreover, according to Flanagan (1987) changes in the sectoral or regional distribution of employment and output have not

[70] Sachs (1986) gives a particularly lucid discussion of the various hypotheses and their empirical relevance. It is interesting - and perhaps offers some hope for the future - that in discussing the apparent rise in the US natural rate during 1970-80, Tobin (1980) reviews the same hypotheses, including hysteresis.

increased mismatches between supply and demand.[71] On the other hand, as documented in several studies [see, for instance, Schultze (1987)], the so-called Beveridge curve (i.e. the relationship between vacancies and unemployment) has clearly shifted which by some [Franz (1987) and Bean and Layard (1988)] is explained by the rising proportion of long-term unemployed.

(ii) Hysteresis. When Friedman and Phelps introduced the natural rate concept, they both noted that it is not a constant but is influenced by various structural factors. If, in addition, the natural rate depends on the historical path of the actual rate, it has the property of hysteresis[72] and this possibility is increasingly mentioned in academic discussions of the European problem.[73] The key question for policy-makers is, however, whether hysteresis is a symmetric property, so that a fall in U would also lead to a fall in U*, and this, in turn, depends on the sources of hysteresis. For instance, if it is mainly caused by a fall in the capital stock, there is little scope for non-inflationary growth unless the upturn is investment-led so that the capital stock increases ahead of employment. Similarly, if hysteresis is the result of declining skills of the long-term

[71] The hypothesis that the rate of unemployment depends (positively) on the regional and/or sectoral employment dispersion was initially proposed by Lilien (1982) and confirmed for US data. It may be regarded as the "mirror image" of another hypothesis (very popular in the 1960s) which states that a given average rate of unemployment will be associated with higher inflation when the distribution of excess supply across sectors and regions is very uneven.

[72] The hysteresis hypothesis was first proposed in Phelps (1972) and is further developed in Hargreaves Heap (1980). A strong form of hysteresis [Buiter (1987)] would satisfy the equation:

$$U_t^* = aU_{t-1}^* + (1-a)U_t$$

which can be rewritten as:

$$U_t^* = (1-a)\sum_{0}^{\infty} a^i U_{t-i}$$

whereby the natural rate is fully explained by the history of the actual rate. The insider-outsider model can be seen as a theoretical basis for this version, whereas the aforementioned studies which relate U* to the proportion of long-term unemployed support a weaker version, where U* is assumed to be trendless.

[73] See, in particular, Blanchard and Summers (1986) and (1988).

unemployed, inflation is likely to accelerate in response to lower unemployment, unless the expansionary measures are targeted in favour of the long-term unemployed. By contrast, if hysteresis is caused by trade unions bargaining on behalf of their employed members, symmetry is likely to prevail. In this case, the rate of inflation becomes a function of changes in U rather than its level, but, as shown by Hargreaves Heap, hysteresis actually restores the long-run trade-off.[74] Yet the policy implications are still uncertain. Buiter (1987) and Gordon (1988b) are strong advocates of expansionary policies, whereas Sachs (1986), using optimal control theory, concludes that the appropriate policy depends on the initial situation and on the relative weights attached to inflation and unemployment in the general welfare function.

As regards the empirical support of hysteresis, there is some indirect evidence that it may have played a role in certain countries. Capital stock growth rates have generally declined and the Okun curves (i.e. the relationship between the rate of capacity utilisation and the rate of unemployment) have shifted. Moreover, the long-term unemployed appear to have a smaller inflation dampening effect than those unemployed for less than one year. On the other hand, assuming that the influence of 'insiders' is mainly related to firm-specific measures of utilisation and that of 'outsiders' to

[74] This may be seen by combining a simplified version of the NRH

$[dw - dw_{-1} = b(U^* - U)]$

with the extreme version of the hysteresis model in given above. If the natural rate in period t is U* and a government decides to reduce unemployment permanently to U**, the rise in the rate of inflation in period t + 1 would be $= -ba(U^{**} - U^*)$ and in the next period $-ba^2(U^{**} - U^*)$. Between periods n−1 and n dw increases further by $-ba^n (U^{**} - U^*)$ and since the acceleration is seen to decline over time the total rise in dw compared with the initial situation would eventually reach:

$\Delta dw = -b(U^{**} - U^*)/(1-a)$.

Hence, the new and lower rate of unemployment (U**) is accompanied by a higher but stable rate of inflation and not by a continuous acceleration.

market-wide measures (such as U), one would expect [Flanagan (1988)] the former to dominate the latter in wage equations. However, except for a few countries [Gregory (1986)], this is rarely observed. In addition, when hysteresis is tested directly and U* in equation (vi) on p. 33 is replaced by a function of U_{t-i}, it is usually difficult to find statistically firm evidence of the hypothesis.[75]

*(iii) Measurement of U**. Because the natural rate is so difficult to measure, most empirical studies have used the NAIRU as a proxy.[76] It is, however, generally recognised that the natural rate and the NAIRU are different concepts [Chan-Lee et al. (1987)], as the former reflects a general equilibrium with the rate of inflation stable but undetermined while the latter indicates the degree of labour market slack required to prevent a given inflation rate from changing. Hence, in periods of unfavourable supply shocks, measures of the natural rate and the NAIRU will differ by a large margin. For instance, an acceleration in import prices would leave the natural rate more or less unchanged while the actual and expected inflation rate

[75] On this point see Chan-Lee et al. (1987), Coe et al. (1988) and Alogoskoufis and Manning (1988). As an example of the uncertainty of estimates in this area, it might be mentioned that Gordon (1987a and b) finds little evidence of hysteresis in European countries, while Gordon (1988b) reverses the earlier results, concluding that (p. 303): "Europe can choose to achieve a permanent increase in output at the cost of a permanently higher but not accelerating inflation rate".

[76] One exception is Coen and Hickman (1988), who present natural rates for four countries. Taking a previous "high employment" year as a benchmark and adjusting only for demographic changes, they obtain the following natural unemployment rates for 1984 (actual rates in brackets):

United States5.2 (7.5)
Germany1.3 (8.4)
United Kingdom1.8 (11.3)
Austria1.8 (3.9)

They also find that in all four countries most of the (U−U*) gap can be ascribed to a shortfall of demand (rather than an excessive level of real wages), but since prices and wages are exogenous in their model, they are unable to estimate the extent to which stronger output and demand growth would be accompanied by higher inflation.

rises. By contrast, the NAIRU would increase, with the actual rise depending on the extent of the import price shock and the degree of real wage rigidity (see Graph 5, p. 35).

Even assuming that the NAIRU was an acceptable estimate of the natural rate, policy-makers would be ill-advised to use existing measures in gauging the degree of slack [see Krugman (1987)]. NAIRUs are very sensitive to the time periods used and to the specification of the wage-price mechanism and for some countries the published figures cover an uncomfortably wide range. Consequently, the safest conclusion with respect to recent changes in European natural rates is that there is suggestive evidence of some increase. However, it is not possible to quantify the rise, nor to identify the principal causes.[77]

(b) Real Wage Targets.

Most analysts agree that the European economies were subjected to severe supply shocks in the 1970s as a strong acceleration in nominal wages was followed by higher import prices and later in the decade by slower productivity growth. As discussed above, a policy aimed at keeping the rate of inflation stable leads to higher unemployment when adverse supply shocks occur, but an important question in this respect is whether U has to be raised permanently. If the supply shock is temporary – as is normally the case – and equation (vi) given on p. 33 is valid, the increase in U will be only temporary. However, if the wage equation also contains a term in the lagged real wage level – as the real wage hypotheses would imply – even a temporary supply shock would leave a permanent effect on U; i.e. the existence of a real wage target would be equivalent to a rise in U* and this influence would remain as long as actual real wages are below the target.

The validity of the real wage hypothesis is mainly an empirical question and most studies have found that it does not hold for the

[77] All of the preceding discussion presupposes that in the early 1970s U and U* were not too far apart. However, all analysts of the issue seem to have taken this for granted.

United States. For Europe the results are mixed. There is strong evidence of real wage effects for the United Kingdom, and some have also found that the hypothesis is not rejected for Germany, Italy, Sweden and the Netherlands. On the other hand, there is little evidence in favour of this hypothesis for France, Belgium and Denmark, which have all experienced high and persistent rates of unemployment. Moreover, empirical tests in this area are still subject to severe statistical problems[78] so that even twenty-four years after Sargan first proposed the real wage hypothesis it remains a promising but unproven proposition.

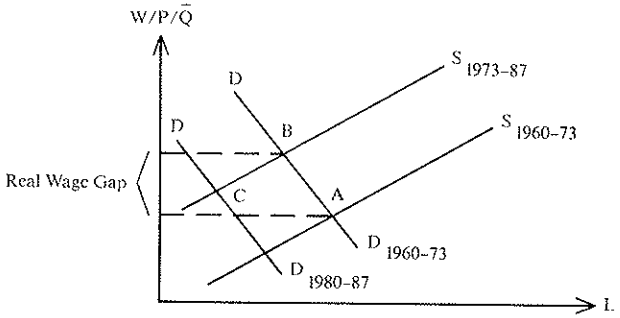
(c) Real Wage Rigidities.

While some analysts regard real wage targets as being equivalent to real wage rigidities, others have adopted the concept introduced in Section III and ascribed the European problem to a weak response of wages to economic slack.[79] In theory, the cyclical sensitivity of European wages might be expected to be lower than in the United States and Japan given the larger share of unionised workers and the

[78] See Hall (1986) and the discussion of estimated price equations on p. 53.

[79] In some of the early analyses of the European unemployment problem real wage rigidities were linked to the "real wage gaps"; i.e. the ratio of actual real wages to productivity relative to some presumed equilibrium level. The underlying model is illustrated in Graph 6 on p. 68, where SS is a labour supply curve, DD the labour demand curve and point A an equilibrium point. Following the first oil shock the labour supply curve shifted to the left creating a real wage gap and at the same time reducing employment so that a positive relation between the real wage gap and the rate of unemployment could be observed. Subsequently, the demand curve has shifted to the left and at present many countries are at a point like C where the wage gap is virtually eliminated but employment is much lower than in the initial situation. The graph also illustrates why in most recent studies [see for instance Gordon (1987a and b) and Schultze (1986 and 1987)] the real wage gap concept has been abandoned as an indicator of rigidities or insufficient supply-side adjustments. While the move from A to B may be interpreted as an exogenous supply-side shift (and is also influenced by the degree of nominal rigidies, see Graph 5), the move from B to C is induced by changes on the demand side and is not indicative of any adjustments on the supply side. In other words, with a more expansionary demand policy the real wage gap would reappear.

Graph 6



tendency to adopt union wages also in the non-unionised sectors. In practice, however, there appears to be little difference between the wage equations for the United States and Europe (see Table 4), whereas the cyclical sensitivity for Japan is clearly higher.

(d) Output Price Constraints.

Just as the wage equation generally has received much more attention than the price equation, most discussions of the European problem have focused on the behaviour of wages and almost totally neglected that of prices. However, since the real wage is not a behavioural variable but determined by separate – though interrelated – movements in nominal wages and prices, a rise in real wages may be due to a higher nominal wage as well as a moderate price increase or a price fall. Moreover, while most have found that nominal wages respond fully to changes in prices, the elasticity of price changes with respect to changes in domestic costs is usually less than unity, suggesting that price behaviour is a more likely source of short-run variations in real wages than wage behaviour.

In fact, for an open economy where firms sell part of their output in world markets or in competition with imports it is not implausible to assume that developments in foreign prices act as a constraint on firms' ability to shift wage-cost increases into higher output prices. Particularly when the exchange rate appreciates or foreign

competitors benefit from lower cost increases, such constraints will lead to an erosion of profit margins and to cuts in labour demand as production on the margin is no longer profitable. This is an important transmission mechanism in Schultze's (1986 and 1987) model of the European problem, and evidence of foreign price constraints is also found in Stiehler (1987). However, one weakness of the price constraint hypothesis is that it is rejected by German data, as German output prices appear to be exclusively determined by unit labour costs. Moreover, given the restoration of profit shares during the 1980s – in several cases to pre-1973 levels – labour demand should have increased either directly as marginal plants became profitable again (assuming that they had not all been scrapped) or indirectly via increases in the capital stock. However, the improvement in profits has not been accompanied by more employment, nor – until this year – by significantly stronger investment.[80]

(e) Demand Management Policies.

Finally, the policies pursued in Europe may have influenced the path of inflation and unemployment in two important ways, though not directly affecting the parameters of the wage-price mechanism:

– policies may have been gradually tightened in the course of the 1980s, so that a downward shift of the short-term Phillips curves (due to lower price expectations) has been offset by a move along the curve as a result of weaker aggregate demand;

– the anti-inflationary policy stance may not have been sufficiently credible, so that inflationary expectations have not adjusted to the actual rate of inflation and to the degree of policy tightness.[81]

[80] Fitoussi and Phelps (1986 and 1988) explain the rise in profit margins by the increase in real interest rates and the real depreciation of most European currencies until early 1985. Moreover, they ascribe the absence of a demand pick-up to a real balance effect resulting from the price rise. There is, however, little evidence that real interest rates directly affect profit margins.

[81] See the discussion of the "inflation floor" on p. 59.

Both effects are plausible and if valid they would leave some scope for a non-inflationary rise in aggregate demand. However, given the absence of generally accepted policy indicators and measures of inflationary expectations, their validity remains an open question.

All in all it appears that the European unemployment problem cannot be related to or explained by one single cause. Rather, a range of different factors have played a role and most of them in the same direction.[82] This also means that the observed path of unemployment and inflation in Europe may be consistent with the NRH as movements along a given Phillips curve have coincided with shifts of the curve. These shifts partly reflect a rise in the natural rate and partly other influences which have more or less the same effect as a rise in the natural rate.

V. Unresolved Issues and Policy Conclusions

It is now about twenty years since the old Keynesian model and the policies based on a permanent trade-off between output and inflation came to an end and there are still several unresolved theoretical and empirical issues regarding the wage-price mechanism.[83] A model based on non-market-clearing wages and prices seems to give a less inaccurate description of the transmission of policy changes to the real economy than the New Classical Model with instantaneous market clearing. However, the latter has provided three important contributions:

[82] One of the factors not explicitly discussed is the higher population and labour force growth experienced in many European countries; see Glyn and Rowthorn (1988).

[83] This is in sharp contrast to theories of the long-run and steady rate of inflation. As noted by McCallum (1987a), there is a wide consensus that an ongoing and steady rate of inflation conforms fairly closely to money growth rates and is largely neutral. Moreover, most analysts view the socially optimal rate of inflation as zero or negative and this proposition is also accepted as a long-run policy target in many countries.

– it has turned attention away from the rather narrow Phillips curve paradigm to consideration of the determinants of the aggregate supply curve and long-run equilibrium conditions;

– it has made forward-looking or rational expectations a standard and generally accepted maintained hypothesis;

– it has revealed the possible influence of policies on behavioural parameters and underlined the importance of credible policies.

Within the New Keynesian Model of the wage-price mechanism, one issue that is not very well understood is the cyclical sensitivity of prices. Various hypotheses predict that prices should respond only slowly to changes in nominal and real demand, but surveys of firms' price behaviour show that prices are not only insensitive to demand but actually follow a counter-cyclical pattern. Falling average costs and discount practices are among the reasons cited, but it is not at all clear why profit-maximising firms should adopt this behaviour.[84] In this context Carlton (1986) notes that rigid prices do not necessarily mean that the price mechanism has failed but merely that additional allocation mechanisms are used to achieve market efficiency. It is perhaps also relevant to recall Solow's (1979a) observation that if prices (and wages) *are* sticky, their policy consequences do not go away because there is no universally settled theory about *why* they are sticky.

With respect to nominal wages, there is fairly firm evidence that they change pro-cyclically, as trade unions become more aggressive in cyclical upturns and firms more willing to "give in". This implies that early signs of inflationary pressures are to be found in labour and raw material markets and not in markets for finished goods. However, the estimated cyclical sensitivities (or Phillips curve slopes) are not very precise. Hence policy-makers contemplating measures to offset the effect of inflationary shocks have to make their decisions without knowing the likely costs in terms of lost output. Moreover, while

[84] Estimated price equations do not provide much help in this respect as the results depend on the specification and econometric methods are not sufficiently sharp to choose adequately between competing models.

most models have adopted Friedman's natural rate hypothesis, the natural rate is even harder to estimate than the cyclical sensitivity of nominal wages. NAIRUs are often used in place of the natural rates, but it is generally recognised that they are poor substitutes.[85] Indeed, available estimates of NAIRUs for a broad range of countries are too volatile to be used as policy targets. Instead, as recommended by Chan-Lee et al. (1987), it may be desirable that macro-policies should aim at stabilising inflation and then let the economies "grind out" whatever rate of unemployment is compatible with that target.

If such a policy were followed, adverse supply shocks would lead to higher unemployment rather than higher inflation and this may in part explain the rise in European unemployment rates in the early 1980s. However, by the same token, favourable supply shocks – such as the 1985-86 decline in oil and non-oil raw material prices – and the gradual reduction of inflationary expectations should lead to lower unemployment. This has not happened in Europe and the persistently high rates of unemployment without any signs of further deceleration of inflation are puzzling and difficult to reconcile with the natural rate hypothesis. Does it mean that this hypothesis does not apply to Europe? Or have there been factors at work pushing up the natural and actual rates when the NAIRUs were falling? Section IV has discussed this issue without coming to any firm conclusions, thus also leaving unanswered the question as to why employment performance has been far more favourable in the United States than in Europe. It is possible, though, that the answer is not to be found in the wage-price mechanism but in the labour demand function. A number of empirical studies suggest that the adjustment of US wages is helped by an unusually rapid response of employment to changes in demand and real labour costs.

Another problem, which complicates not only the evaluation of the European situation but policy-making in general, is that the

[85] Tobin (1984) notes that the "natural rates" calculated for the 1970s tell more about the natural rate of oil consumption than about the natural rate of unemployment. See also Solow (1986) on this point.

natural rate hypothesis only holds in the very long run. Over periods of four to five years there *is* a trade-off due to lags in the wage-price mechanism. It is conceivable that the path of inflation and unemployment in Europe (see Graph 1) merely shows a particularly slow adjustment process, although the parameters of the price and wage functions do not point to longer lags than for the United States. More generally, the existence of a trade-off for periods corresponding to the time horizon of most policy-makers also creates a risk that policy decisions will be myopic and need to be followed by corrective actions later on.[86]

While it is generally agreed that a high degree of nominal or real rigidity in the wage-price system causes anti-inflationary policies to be accompanied by "real costs", there is less agreement as to which type of rigidity is the more important one to policy-makers. The American literature tends to stress the influence of nominal rigidities, and several prominent economists have recommended indexation – particularly of wages – as a means of shortening the lags and reducing the real costs associated with anti-inflationary policies. At the same time, given the experience of large and unfavourable supply shocks, the European literature has been mostly concerned with ways to reduce real wage rigidities. Most analysts recognise that real rigidities worsen the impact of unfavourable supply shocks, but there are differing views regarding the desirability of more flexible real wages when shocks originate on the demand side. The most recent studies suggest that rigid real wages are less destabilising than flexible wages, thus supporting earlier views by Irving Fisher and Lord Keynes. However, this issue is probably not yet settled.

What do the theories and analyses reviewed above imply for monetary policy? Perhaps two observations are worth making in

[86] As noted by Modigliani and Papademos (1978), a policy-relevant trade-off also exists when the Phillips curve is vertical if policy decisions are based on discounted future values of unemployment and inflation. For instance, a fall in unemployment now may be traded off against a higher but discounted future rate of inflation, with the actual trade-off depending on the discount factor and the weights assigned to inflation and unemployment in the policy-maker's welfare function.

concluding this paper. Firstly, the emphasis on policy-sensitive behavioural parameters of the New Classical School opens the way for affecting sluggish wage and price adjustments directly through expectations and the "credibility" of policy actions. In reality, such direct influences seem to have been difficult to achieve and one problem is that a "regime shift" does not depend on monetary policies alone. Secondly, the deregulations and financial innovations of recent years have fundamentally changed the transmission mechanism of monetary policy changes. One effect of these changes[87] has been that when the simple correlations between income and money supply growth shown in Table 1a are broken down into shorter periods, the 1980s show a marked deterioration in a large number of countries,[88] leading several central banks to abandon or suspend the use of monetary aggregate targets. Yet, even though the wage-price mechanism has recently been more stable than velocity and the transmission mechanism of monetary policy, there is little reason to abandon the medium-term strategy while some authorities are searching for an alternative nominal anchor. Indeed, continued stability of the wage-price mechanism is likely to go hand-in-hand with the continuation of a stable and cautious policy approach.

[87] A second effect, according to a recent survey [Chouraqui et al. (1988)] is that the real influence of monetary policy has been strengthened, particularly because aggregate demand has become more sensitive to changes in nominal and real interest rates.

[88] See Friedman (1988).

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