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REAL WAGES, INFLATION AND UNEMPLOYMENT

by P.S. Andersen

BANK FOR INTERNATIONAL SETTLEMENTS
Monetary and Economic Department
BASLE

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In a recent article on this subject Malinvaud (1982) noted that whereas for most of the post-war period studies of wages and unemployment had been concerned with the question of how sensitive nominal wages are to the rate of unemployment, today (and similarly in the 1930s, see Rueff (1951)) many deal with real wages as a cause of unemployment.

This paper attempts to analyse "both sides" of this two-way causality. It starts by summarising the main features of the unemployment → nominal wage nexus (the Phillips curve), and then considers various ways of adding real wages to the list of wage determinants. When real wages are introduced in the form of employees' wage targets the analysis can still be confined to a relatively simple framework, while consideration of the employers' side takes it into recent works on labour-market theory. These have been concerned with the relative rôles of real wages and output in determining the demand for labour and employment, and this is where the "other side" of the wage → unemployment nexus comes in.

Having presented the analytical arguments, the paper tests them against the empirical evidence for six countries (the United States, Germany, the United Kingdom, the Netherlands, Belgium and Denmark). These tests are carried out in two stages. Firstly, the employees' side is studied by adding pre-tax and post-tax real wage targets to a traditional Phillips curve and, as a "by-product", the existence of tax-push effects is also tested. Secondly, the employers' side is analysed, but since this involves the real wage → unemployment nexus, it is tested by decomposing the rise in unemployment into two elements: one that is related to weak output growth and another which can be associated with the development of real wages.

The usual caveats apply to the empirical results, and the evidence is not equally strong (or satisfactory) for all the countries considered. However, several tentative conclusions emerge: firstly, employees' real wage targets have played a rôle in the inflation process and in some countries there is also evidence of tax-push effects; secondly, real wage costs do seem to influence the rate of unemployment along with output growth. This appears to have been the case in the European countries during the ten-year period up to the mid-1970s, while real wage effects have been much smaller, though not completely absent, in the United States; and, thirdly, this influence of real wage costs not only adds an element of instability to the traditional Phillips curve, but provides a "built-in stabiliser" to the inflation process. It further suggests that a permanent reduction of unemployment requires both real wage moderation and stronger output growth. Judging from past developments, a lowering of real wages is not sufficient to spark off a self-sustaining growth process; at the same time, a recovery based on faster output growth with no real wage moderation runs the risk of aborting at a relatively early stage.

I. Introduction

Most of the macro-economic models currently in use explain the rate of change in wages with the level of unemployment and the actual or expected rate of price inflation as the principal determinants (the augmented Phillips curve). The rate of price change is modelled as a mark-up on unit costs, and employment is "driven by" aggregate demand for output, with relative or real factor prices having either no impact or only a marginal one. The wage and price relations may be combined into a first or higher order difference equation (in either prices or wages) which is dynamically stable, although to some extent this is the result of assuming exogenous exchange rates.

The Phillips curve has evolved over time as new variables have been added and the contribution to annual wage growth of the various wage determinants has changed.[1] Nonetheless, it has essentially remained a disequilibrium approach with movements in either nominal or real wages being "driven by" the degree of excess demand in the labour market. The latter, measured by the rate of unemployment, is taken to be exogenous, and this has two implications: firstly, the Phillips curve is neutral with regard to supply and demand-induced changes in the rate of unemployment; and, secondly, those factors - including the rate of wage inflation itself and the ensuing wage/price ratios - which may affect the demand for and supply of labour are ignored. Consequently, the inflation process is isolated from other behavioural relationships, and, despite its dynamic stability, there is a risk that wage and price changes may not be consistent with equilibrium in labour and product markets.[2]

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1 During most of the 1960s wage developments were largely explained by the degree of excess demand. In the more inflationary 1970s current wage changes were dominated by past price and wage changes, while the rate of unemployment, though statistically significant, provided a relatively small contribution.

2 If certain assumptions are made about the formation of inflationary expectations and the degree of money illusion on the part of wage-earners, it is possible to derive a "non-accelerating inflation rate of unemployment" (NAIRU). However, this rate is not related to market-clearing conditions, nor can these conditions be derived from the empirical estimates. Similar arguments in favour of linking the wage formation process to the labour market may be found in Nickell (1984).

At the same time, there has been a parallel development in the theory of wage determination which, at the empirical level, differs from the Phillips curve approach by adding the lagged level of real wages to the explanatory variables. This alternative theory is often referred to as the "real wage hypothesis", but its influence and significance go far beyond the mere addition of another variable:

- by incorporating lagged real wages, the change in nominal or real wages can be more closely related to long-run market-clearing conditions.[1] In this context, it is relevant to distinguish between two versions of the real wage hypothesis,[2] which, in turn, are based on parallel developments in the analysis of labour markets and on the now well-known distinction between Keynesian and classical disequilibrium régimes;[3]

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1 Some recent models based on the rational expectations hypothesis (REH) go even further, with current wage and price changes being seen as continuously clearing labour and product markets. In this type of model the link between market-clearing conditions and the inflationary process is complete and instantaneous and not just imposed as a long-run constraint. However, in one of the few studies of this issue, Rosen and Quandt (1977) rejected the hypothesis that labour markets are continuously clearing, and the empirical evidence also rather clearly points to lags in the wage and price formation process. It seems more fruitful, therefore, to impose or search for market-clearing conditions as a long-run constraint, and the more extreme REH-based models will not be discussed in the following.

2 While these two versions of the real wage hypothesis originate from different analytical frameworks, a third source is of a purely empirical nature. It has frequently been observed that current wage changes are more dependent on changes in the rate of unemployment than on its level. As will be shown in Annex II, the real wage hypothesis can under certain assumptions be transformed into a wage equation where the weighted sum of current and lagged changes in the rate of unemployment together with expected price changes are the principal wage determinants.

3 These developments in the analysis of inflation and labour markets seem to have been largely independent of each other. It is interesting that both stress the importance of real factor prices and in doing so explicitly or implicitly apply classical or neo-classical theories and conditions.

- regardless of the underlying hypotheses and assumptions the introduction of lagged real wages among the wage determinants fundamentally changes both the rôle of price expectations and the response of current wages to fluctuations in unemployment and relative prices.

As an illustration, consider a simple model where the rate of change in nominal wages (w) is determined by the degree of excess supply in the labour markets ($S_L - D_L$) and the expected rate of price inflation (p^e):

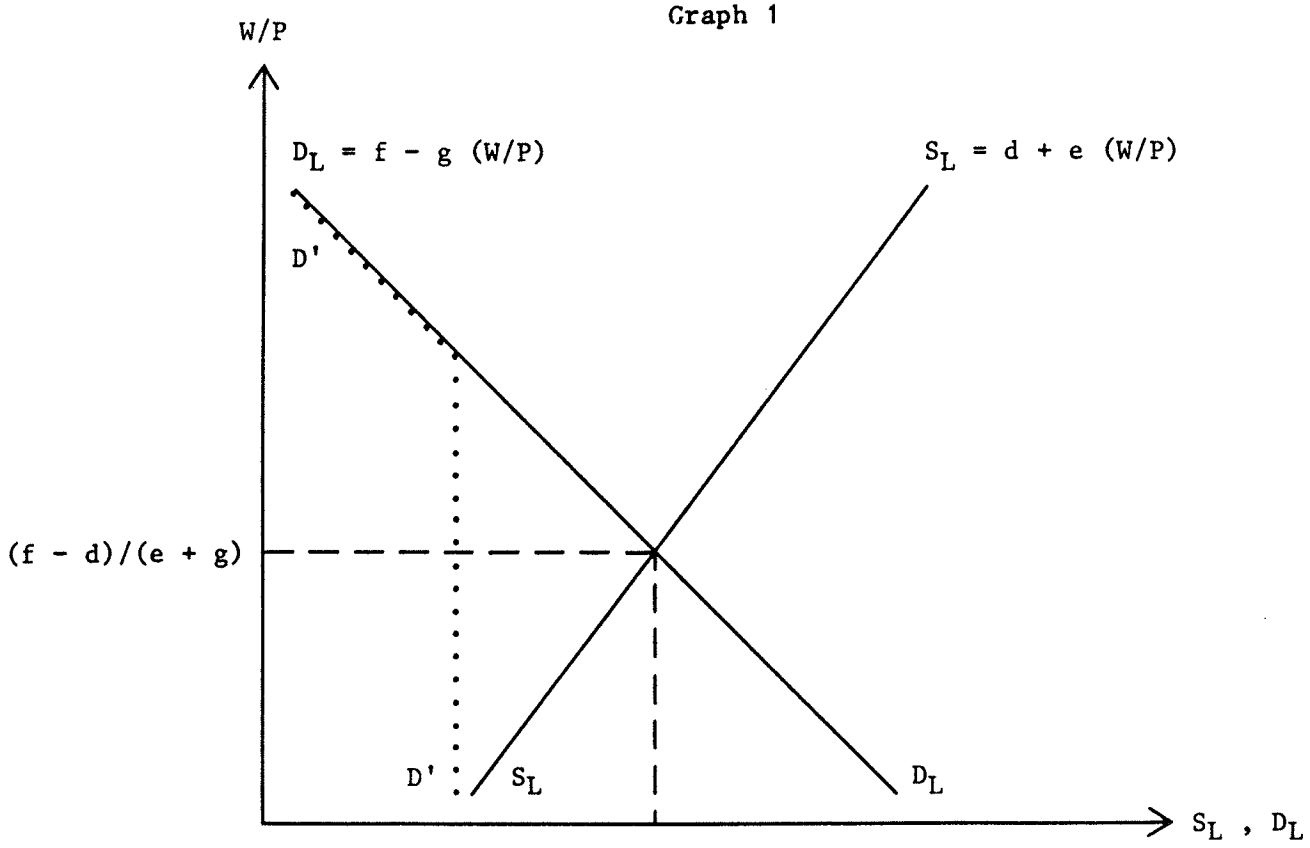
(i) $\quad w = a - b\,(S_L - D_L) + p^e$

When $(S_L - D_L)$ is measured <u>directly</u> by the rate of unemployment (U)[1] equation (i) becomes the Phillips curve:

(ii) $\quad w = a - b\,U + p^e$

but one might also proxy $(S_L - D_L)$ by the determinants of labour demand and supply. Assuming that the labour market can be represented as in Graph 1, this would imply:[2]

Graph 1



1 There are numerous alternative direct measures, of which the inverted rate of unemployment (1/U) and the difference between the number of unemployed and the number of vacancies are probably those most frequently used. The following will consider only the linear version as shown in (ii).

2 This introductory presentation ignores labour-market productivity, but this will be remedied in Section II, B, below.

(iii) $w = a' - b' (W/P) + p^e$ where

$a' = a - b (d-f)$ and

$b' = - b (e + g)$

Changes in nominal wages are now a negative function of the level of real wages, while the rate of unemployment no longer appears. Moreover, assuming that wage-earners correctly anticipate the rate of price inflation, the labour market is in equilibrium for $W/P = (f-d)/(e+g)$ (i.e. at the intersection of S_L and D_L) as real wages are constant.

However, this approach is more problematic than is immediately evident from Graph 1:

- the real wage concepts relevant to employees and employers respectively are not identical. Thus labour supply is likely to depend on real take-home pay - $(W/P)_S$ - which may be measured by post-tax earnings deflated by consumer prices. By contrast, labour demand is influenced by total labour costs (i.e. pre-tax earnings plus all non-wage labour costs, including payroll taxes) deflated by output prices - $(W/P)_D$. Consequently, the tax system, but also deviations in output and consumer price changes, create a "wedge" between the real wage as seen by the two sides of the labour market,* and in equations such as (iii) it is necessary to use two measures of real wages;

- the labour market cannot be analysed independently of the product market. This particularly affects labour demand, as the downward-sloping D_L-curve presupposes that firms' output prices are given exogenously. If, instead, firms plan output and employment on the basis of expected aggregate demand (i.e. they face an output constraint instead of a price constraint) employment only depends on aggregate output (Y) and the labour demand curve will look like D'D'.

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* This "wedge" can be important. For instance, in the US manufacturing sector real post-tax hourly earnings were virtually unchanged over the period 1965-81, while productivity increased at an annual rate of 2.2 per cent., suggesting moderate wage behaviour. Over the same period, however, employers' real hourly wage costs increased at an annual rate of 2.9 per cent., thus putting a squeeze on profits.

Assuming that $D'D' = h \cdot Y$, two alternative expressions for the rate of change in nominal wages may be considered:[1]

(iiia) $$w = a' - be\ (W/P)_S - bg\ (W/P)_D + p^e$$ and

(iiib) $$w = a - bd - be\ (W/P)_S + bh\ Y + p^e$$

In (iiia) w will be strongly influenced by real wages while in (iiib) the rôle of real wages only depends on the elasticity of labour supply, which is often found to be rather low, though not well determined.

As they stand, equations (iiia) and (iiib) are relatively easy to estimate, but one usually does not know which is relevant at a given point in time. Moreover, the situation in the labour market is likely to change over time, so that in some periods real wages will be important while in others nominal wage changes mostly depend on output and unemployment. This, in turn, implies that variables enter the nominal wage equation discontinuously, and there is, as yet, no satisfactory and generally accepted way of estimating such relationships.

One "second-best" solution is to combine (iiia) and (iiib) into one general expression and let the estimated coefficients decide the importance of each variable. This is the approach adopted by Wren-Lewis (1982), but, even though he obtained encouraging results for the United Kingdom, it has not been applied here, mainly because for annual data it leaves very few degrees of freedom.[2] An alternative - though still "second-best" - approach is to estimate (iiia) and (iiib) separately and compare their statistical and economic properties both individually

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1 When the rate of unemployment is closely correlated with the level of output, Y may be replaced by u in (iiib). However, some recent models for the United Kingdom suggest that output is a better indicator (see Grubb (1983) and Wren-Lewis (1982)), although it cannot be excluded that it merely proxies productivity developments.

2 Wren-Lewis had 49 quarterly observations, but, allowing for lags on most of the explanatory variables, the estimating equation had only 29 degrees of freedom. In the sample to be tested in this paper there are only 17 annual observations for each country.

and relative to an expectations-augmented Phillips curve. When extended to several countries this gives a further dimension of comparison, and this is, with some modifications, the approach adopted in this paper.

However, before discussing the empirical results in Section III, the following section first summarises the essential features of the Phillips curve approach and then presents the two versions of the real wage hypothesis. Section III reviews earlier empirical work with lagged real wages among the wage determinants. Most of these estimates concern the United States and the United Kingdom, and the main purpose of this section is to test the evidence on a broader country sample. The final section summarises the preceding analysis and the empirical results, and attempts to draw some tentative conclusions.

II. Wage hypotheses

A. Phillips curve

The wage and price formation process contained in most macro-economic models is explained in more technical terms in Annex I, emphasising the following main features:

- judging from the empirical estimates usually obtained, the inflation process is dynamically stable in the sense that in the absence of external disturbances it will converge towards constant and stable rates. However, the adjustment is subject to long lags, particularly if the degree of real wage rigidity is high;
- when prices are determined by a (cyclically insensitive) mark-up on unit costs and domestic and foreign prices increase at approximately the same rate, real wages will tend to grow in line with labour productivity.

For much of the post-war period these conditions were satisfied in most countries, and the implied link between real wages and productivity - together with the slow rate of change in foreign prices - probably explains why modelling the inflation process along these lines was compatible with a relatively stable distribution of factor incomes. In

other words, even though wages and prices were modelled as changes while the income distribution was determined by the levels of wages and prices, major inconsistencies did not appear, and the inflation process could largely be analysed and explained in a sub-model which was isolated from other behavioural relations and ignored longer-run equilibrium conditions.*

In the 1970s, however, when foreign prices accelerated relative to domestically determined prices and productivity growth in many countries subsequently fell to below earlier trends, the potential weaknesses of this model framework started to appear: (i) the nominal wage change associated with a given rate of unemployment rose sharply in virtually all countries, giving the impression that the Phillips curve was "breaking down"; and (ii) in many countries the rise in prices was less than the increase in unit costs, resulting in a marked shift in the distribution of factor income in favour of wage-earners.

While there are many ways of interpreting these simultaneous events, one immediate and obvious implication would seem to be that the problem of inflation can no longer be analysed in isolation. Firstly, the actual or expected rate of inflation is likely to influence economic behaviour as well as the policy measures adopted. Secondly, such behavioural changes will feed back into the inflation process, thereby changing the rôle of traditional wage determinants and adding an element of instability. The following discussion considers only the second of these issues, as it presents various ways of incorporating equilibrium and steady-state conditions more explicitly in the wage formation process.

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* From the three-equation model shown in Annex 1 it is possible to derive a level of unemployment which is compatible with a stable rate of inflation. This is the NAIRU referred to above, and the fact that it is consistent with any rate of wage increase clearly underlines the extent to which the inflation sub-model is isolated from other equations.

B. Real wage models of inflation

As briefly discussed in Section I, the rôle of lagged real wages as an argument in the wage equation can be derived from labour demand and supply. In this context one can draw on recent developments in the analysis of labour markets and distinguish between two alternative formulations of the real wage hypothesis: a supply-side version which assumes that the labour demand curve in Graph 1 is vertical (i.e. a Keynesian régime) and relates the influence of real wages to the behaviour of employees; and a demand-side version, where the rôle of real wages is derived from the employers' side on the assumption that output prices are determined exogenously.

(a) The bargaining or supply-side real wage model

This approach was pioneered by Sargan (1964) and is still being used in most current models for the United Kingdom. A distinctive feature is that the influence of real wages on current wage changes depends not on the slope of the labour supply curve (which, as noted earlier, is difficult to identify empirically) but on shifts of this curve, which, in turn, are related to developments in real wages. Thus wage-earners are assumed to have certain targets with respect to the level of real wages, and when actual real wages are below the target, the supply curve in Graph 1 will be far to the left, reducing the degree of slack and putting upward pressure on nominal wage changes. The hypothesis, therefore, assumes a negative relationship between the lagged level of real wages and current wage changes. Moreover, the rate of unemployment can affect the target or the speed with which wage-earners attempt to close the gap between actual and target real wages. Average or marginal tax rates may also appear, as the target can be set gross or net of taxes, leading to the following equation for nominal wage changes:*

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* The derivation of this equation together with various adjustment schemes is discussed in Annex II.

$$\text{(iv)} \quad w_t = a - b\,U_t + c\,W_t^* - d\,\log(R \cdot W/PC)_{t-1} - e\,\log\,(R_t/R_{t-1}) + f\,p_t^e$$

where, in addition to the notation explained earlier, the following variables have been introduced:

W^* = target real wage rate

R = retention ratio or one minus average tax rate

PC = consumer prices.

When implemented empirically W^* is usually assumed to grow along a constant trend, and the coefficient with respect to changes in the retention ratio can be used in assessing the strength of tax-push effects. The rôle of unemployment is similar to that of a Phillips-curve formulation, while the introduction of lagged real wages considerably changes the likely influence of price expectations.* On the one hand, with lagged real wages putting upward pressure on nominal wage changes as long as they are below target, employees are essentially "backward-looking" and expectations should play no rôle. On the other hand, the assumed adjustment process can display various degrees of nominal or real wage rigidity, and, as shown in Annex II, this will affect the a priori impact of price expectations, with very rigid real wage behaviour implying a price expectations coefficient of unity.

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* The introduction of lagged real wages also has important implications for the response of nominal wages to changes in relative prices and exchange rates. Since these are mainly of a longer-run nature, they are not discussed in this paper, but interested readers may wish to consult Artis and Miller (1978) and Freedman (1977).

(b) The classical régime and the demand-side real wage hypothesis

This is both the simplest and the most complicated case to analyse. If the "wedge" between employers' and employees' real wages can be ignored, all prices are determined exogenously in competitive markets and firms expand output and employment until real wages equal labour productivity, the labour demand curve corresponds to $D_L D_L$ in Graph 1 and the rate of unemployment is a simple function of the ratio between real wages and labour productivity. Allowing also for the influence of inflationary expectations, this leads to a wage equation with only real wages (W/P), productivity (Q) and price expectations (p^e) as determinants:[1]

(v) $$w = a - b \log ((W/P)/Q) + c\, p^e$$

However, despite some encouraging empirical results[2] there are a number of problems with (v).

Firstly, short-run wage movements are unlikely to take place along the demand curve for labour, suggesting that the equality of productivity and real wages should only be imposed as an underlying and long-run condition. Applying a partial adjustment scheme and assuming further that the measured rate of unemployment will influence bargaining strength or the speed of adjustment, (v) can be transformed into:[3]

(vi) $$w_t = a - b \log ((W/P)/Q)_{t-1} - c\, U_t + d\, p^e_t$$

which is very similar to the supply-side version, except in two important respects: productivity is used instead of a time trend, and wages include taxes and are deflated by producer instead of consumer prices.

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1 A lucid presentation along similar lines can be found in Pitchford (1981).

2 See McCallum (1974) and (1976).

3 This is the formulation adopted by Kuh (1967), who first suggested a productivity based wage hypothesis as an alternative to the Phillips curve. It has also been used in Section III in a preliminary test of the demand-side hypothesis.

Secondly, productivity and real wages may be "spuriously" correlated when the analysis is based on aggregate figures. In conditions of real wage pressures the least efficient firms are forced to close down, thereby increasing average labour productivity and dampening the rise in the (W/P)/Q ratio. Nonetheless, the rate of unemployment will tend to increase (thereby lowering inflation), suggesting that the equation should be specified with separate coefficients for W/P and Q.[1]

Thirdly, within the wider context of trying to model the inflation process, the term (W/P)/Q (which is easily seen to be identical with the now widely used "real wage gap" concept) is ambiguous. For instance, in a situation where the real wage/productivity ratio has increased relative to historical trends (i.e. where there is a real wage gap), two interpretations are possible:

- if firms are unable to raise prices, the real wage gap is a proxy for growing unemployment as firms, through cutbacks, attempt to improve their profits. In this case there would be a tendency towards lower wage inflation;

- if the assumption of exogenously determined prices is relaxed and replaced by a mark-up pricing scheme, a real wage gap is more likely to serve as an indicator of the "struggle for income shares" as firms attempt to recoup the loss in profits through higher prices which are followed by higher wage claims.[2] Consequently, the sign of (W/P)/Q will be positive.

While the last observation might suggest that the estimated sign of the real wage productivity/ratio could be used to identify disequilibrium régimes, a more essential question is whether the demand-side version should be interpreted as a model of inflation. Thus, when

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1 Another problem, of course, is that in the short run productivity changes tend to be pro-cyclical, thus casting some doubt on the classical assumption of a downward-sloping demand curve for labour.

2 See Benassy (1978) and Modigliani and Scioppa (1978), who interpret the real wage/productivity ratio as an indicator of the "degree of inconsistency" between income share targets. Sachs (1983) incorporates both interpretations in his empirical estimates, as a large real wage gap is found to increase unemployment as well as the rate of inflation.

the classical assumption of exogenously determined prices is taken literally, the immediate response to external shocks is a change in labour-market conditions rather than a change in the rate of inflation. Consequently, it seems more appropriate to assess the validity of the demand-side version from more indirect tests, including:[1] (i) reduced-form employment equations, which measure the possible influence of real wages (and other factors) on the rate of unemployment; and (ii) producer and consumer price equations which may be used in identifying price constraints. According to the first test, a significant and positive coefficient with respect to the real wage gap would suggest that the level of unemployment, through employers' reaction, is related to the outcome of the inflation process.[2] Moreover, the Phillips curve will be unstable and may, depending on the course of real wage costs relative to productivity, become increasingly inflationary. From the second test a strong influence of export and import prices can be taken as evidence of constraints on firms' ability to shift higher costs into prices. In addition, estimates of the lag structure can be used in assessing the extent to which such constraints are of a temporary or permanent nature.

III. Empirical evidence

A. Review of earlier estimates

Phillips curve estimates are available for practically all industrialised countries, but the real wage hypothesis has so far been tested for only a few. Most of the evidence concerns the United Kingdom, and a few estimates are also available for the United States, Canada and Japan. In the case of the United Kingdom, all equations except one are based on the Sargan model focusing on the supply side; the same applies to Canada, while in the case of the United States and Japan the estimates refer to the demand side. Another and more recent feature in the United Kingdom is the replacement of the rather restrictive partial adjustment mechanism with the error correction model (see Annex II),

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1 Another indirect test is provided in D. Grubb et al. (1983), which ascribes the rise in unemployment to real wage rigidity in the face of lower productivity growth and unfavourable changes in the terms of trade.

2 This endogenous element may be more specifically linked to profitability conditions in the exposed or competitive sectors, see Courbis (1980).

which allows a more general lag structure and explicit tests of long-run steady state conditions.

It would take too long to summarise all the empirical results,[1] but as a supplement to the theoretical discussion it is useful to review the evidence concerning the change in coefficients when the level of real wages is introduced as a determinant of nominal wage changes:

(i) rate of unemployment: in virtually all equations for the United Kingdom the rate of unemployment, though included in the underlying hypothesis, has no effect on the change in nominal wages. An exception is Wadhwani (1982), who finds a significant effect of unemployment when the target real wage rate is proxied by a moving average of past wages. However, since he also finds that actual and targeted real wages enter the equation with identical coefficients (in absolute terms), the link to the real wage level has effectively been cut, and the specification is similar to an expectations-augmented Phillips curve with a rather complicated lag structure in prices and wages. In the case of Canada the rate of unemployment is significant when price expectations are left out, while neither McCallum's specification for the United States nor the Japanese model include unemployment;[2]

(ii) price expectations: among the most interesting empirical results are those relating to price expectations. It will be recalled from the theoretical discussion that in the real wage model the a priori coefficient could range from zero to unity depending on initial assumptions with respect to the adjustment mechanism, and this is largely confirmed when price expectations are proxied by an adaptive scheme, as the coefficients are less than unity and frequently not significantly different from 0. However, when p^e is approximated by a rational scheme the coefficients are much higher and in several cases not different from unity in the long run.[3] To what extent this finding has implications for the underlying adjustment mechanism remains to be explored, and, of course, the effects

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1 It is also unnecessary, as excellent reviews can be found in Henry (1982 and 1983) and Ormerod (1982).

2. In his estimates for the United States, which only cover the period 1950-1960, Kuh finds that the change in, rather than the level of, unemployment is the major determinant of nominal wage changes.

3. In fact, Ormerod (1982) finds for the United Kingdom that the long-run coefficient is higher than 1.

of rational expectations will ultimately depend on the overall model structure from which they are being derived;

(iii) real earnings v. real product wage: as noted earlier, most estimates for the United Kingdom are based on the Sargan model, which focuses on the supply side and real earnings. However, the latest model by the London Business School obtains promising results from an equation where nominal wages are deflated by manufacturing output prices, and the same applies to the McCallum model for the United States (GNP deflator) and to the equation for Japan (wholesale prices);

(iv) levels v. rates of change: the change in nominal wages has usually been used as the dependent variable, although Agarwala et al. (1972) find that in the case of Canada the level of real wages (consumer prices used as deflator) can largely be explained by labour productivity, the rate of unemployment and the share of the labour force which is unionised. The study for Japan (see Kazutoshi (1982)) attempts to explain the level of nominal wages using wholesale prices, raw material prices and productivity. This approach (assuming profit maximisation) is found to perform better than a Phillips curve model, although a direct comparison is difficult, given the different specifications of the dependent variable. Moreover, the price coefficients are considerably above unity in absolute terms (4.2 and -2.3, respectively), entailing a risk of unstable wage-price dynamics;

(v) gross v. net earnings: estimates of the influence of taxes in the context of the real wage model are virtually confined to the United Kingdom, although discussion of possible tax-push effects has also taken place in other countries. For the United Kingdom there is quite strong evidence that tax rates play a rôle, but it is uncertain whether it is the level of or the change in tax rates which affects current changes in nominal wages. This casts some doubt on the effectiveness of tax reductions as a means of achieving a permanent reduction in the rate of inflation;

(vi) lags: as noted earlier, rather complicated lag structures have been estimated for the United Kingdom, including several lags of the dependent variable among the determinants of current wages. The evidence seems to indicate that only one lag for the dependent variable is significant, and the coefficient implies a relatively short time lag.

In reviewing earlier work, mention should also be made of empirical studies concerning the impact of real wages on employment and thereby, indirectly, on unemployment and the rate of inflation. Numerous studies have appeared in recent years and it is not possible to review them in detail. However, two general conclusions might be noted:

- with only a few exceptions all studies find that changes in employment and unemployment are dominated by movements in output, and some also find that changing commodity and energy prices have an impact, though the sign of this effect is ambiguous;

- the estimates concerning real wages cover a very wide range, as some find no effect at all while others report a highly significant and sometimes dominating influence. It appears, however, that whenever real wages affect employment and unemployment the impact is subject to much longer lags than that of output.*

B. New estimates

The preceding discussion has covered a wide range of issues, many of which could be tested empirically. In the space available, however, only some of these tests will be undertaken and, in particular, questions concerning the long-run and dynamic structure of the wage formation process are treated only superficially. Instead, the main purpose of the following is to see whether:

(i) adding lagged real wages to an expectations augmented Phillips curve yields significantly better results and changes the impact of other wage determinants;

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* In this context, two modifications might be added to the earlier distinction between classical and Keynesian régimes and their implications for real wages and employment. Firstly, in a situation where the elasticity of substitution between capital and labour is very low and firms are close to their capacity limits, real wages have virtually no effect on employment and there is likely to be some measure of "capital shortage unemployment". Secondly, the arguments presented so far only analyse real wages from the cost side. Since the spending propensity of employees usually exceeds that of employers, inclusion of demand-side effects might - at least in the short term - produce a positive relationship between real wages and employment. This poses a problem for empirical work, as in the short run these effects may dominate while in the longer run supply-side influences will gradually take over. For further discussion see Malinvaud (1982) and Roth (1982).

(ii) employee wage targets are set with respect to pre-tax or post-tax real wages and, in the latter case, to evaluate the strength of tax-push effects;

(iii) labour demand factors have an impact on the wage formation process. This is tested in two ways: firstly, by adding a real wage gap measure to the expectations-augmented Phillips curve; and, secondly, by estimating employment and price equations.[1]

The empirical estimates cover six countries and are based on annual data. Except for the Netherlands and the equations including changes in the retention ratio, the observation period is 1965-82[2] and the following four wage equations were used:

(i) an expectations-augmented Phillips curve with the lagged dependent variable included to capture possible lags:

$$w_t = a - b\,U_t + c\,p_t^e + d\,w_{t-1}$$

(ii) pre-tax and post-tax versions of real wage equations based on supply-side considerations:

$$(a)\quad w_t = a - b\,U_t + c\,p_t^e + d\,w_{t-1} + e\,t - f\,\log\,(W/PC)_{t-1}$$

$$(b)\quad w_t = a - b\,U_t + c\,p_t^e + d\,w_{t-1} + e\,t - f\,\log\,(R\cdot W/PC)_{t-1} - g\,\log\,(R_t/R_{t-1})$$

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1 A very similar approach can be found in Sachs (1983). Although the specifications differ, Sachs' results are very close to those shown in the following except that he finds a more significant difference between the United States and Europe (in particular Germany). On this latter point see also Gordon (1983), Hickman and Klein (1984) and Kahn (1984).

2 The US Bureau of Labour Statistics (BLS) provides comparable wage, productivity and employment figures for 12 industrialised countries (manufacturing sector) for the period 1950-82. However, comparable tax and retention rates are only available for the period 1965-81. In the case of the Netherlands, inclusion of 1982 led to a considerable deterioration of the results, implying that the parameters reported below must be interpreted cautiously.

(iii) a real wage equation derived from the labour demand side:

$$w_t = a - b\,U_t + c\,p^e_t + d\,w_{t-1} - e \log ((W/PO)/Q)_{t-1}$$

The employment function was estimated using a reduced-form equation, with the rate of unemployment as the dependent variable and product market slack, and the ratio between real wage costs and productivity as the main determinants.[1]

$$\text{(iv)} \quad U_t = a - b\,GNP\,GAP_t + c \log ((W/PO)/Q)_{t-1}$$

Finally, both producer and consumer prices were specified as mark-up functions, with input costs measured by unit labour costs, lags allowed for by including both current and lagged values and the lagged dependent variable, and cyclical factors proxied by product market slack.[2] The rate of change in export prices was included as a measure of

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1 This specification ignores changes in the labour force. To the extent that the labour supply is positively influenced by real earnings and the latter are correlated with real wage costs, the c-coefficient in equation (iv) will have an upward bias and reflect both demand and supply effects (see also Graph 1). Equation (iv) was also estimated without constraining the coefficients on productivity and real wage costs to be of the same size (in absolute terms), since, as mentioned earlier, productivity increases may be influenced by the development in real wage costs. In most cases, the data did not allow separate coefficients to be estimated, but for Belgium and the United Kingdom the unconstrained version was significantly better and some improvement was also recorded for the Netherlands. Moreover, in all three cases the size of the coefficients suggested that productivity increases contain an important endogenous element. Some recent works on the United Kingdom are also interesting in this respect. Morley (1979) argues that unemployment over the period 1954-76 can be explained exclusively by relative prices (measured by the lagged profit share of income) while output slack has no measurable impact. Taylor and Cunningham (1982) question this result and explain unemployment in terms of output slack and the rate of output growth, while Morley (1982) in a subsequent response allows for a dummy shift variable in his earlier equation. The data used in this paper confirm the importance of the profit share in explaining unemployment in the United Kingdom. However, an equation including only the profit share as the determinant of unemployment was found to contain a high degree of autocorrelation suggesting some "missing variables".

2 Trend deviations of both industrial output and gross national product were tested, but except in one case (the consumer price equation for the United States) the coefficients were either insignificant or of the wrong sign.

possible price constraints in the producer price equations, whereas for consumer prices the change in import prices was added as an indicator of both constraints (through foreign competition on domestic markets) and additional input costs.[1] Finally, for both equations an intercept term was initially included but eventually had to be suppressed in order to facilitate comparisons:[2]

$$(v) \quad po_t = - b \text{ OUTPUT GAP}_{t-i} + c\ ulc_{t-i} + d\ imp_{t-i} + e\ po_{t-1}$$

$$(vi) \quad pc_t = - b \text{ OUTPUT GAP}_{t-i} + c\ ulc_{t-i} + d\ imp_{t-i}\ e\ pc_{t-1}$$

Turning first to the estimates for equations (i) and (ii) (Table 1), there is a clear improvement when real wages are added to the Phillips curve for Belgium, Denmark, Germany and the United Kingdom. In the Netherlands the bargaining model based on pre-tax real earnings performs as well as the Phillips curve, while for the United States neither pre-tax nor post-tax earnings equations provide support for this approach.

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1 Since producer prices are measured by the value added deflator for manufacturing and the CPI-index of consumer prices is based on gross output, prices of intermediate goods should - in theory - have no influence on producer prices but need to be included in the specification of consumer prices.

2 In most cases the intercept was close to zero, but when significant it was found to have a considerable impact on the coefficient of the lagged dependent variable.

Table 1 Wage equations: Phillips curves and bargaining models.[1]

Countries	Constant	Trend	U	p^e	w_{-1}	$(W/PC)_{-1}$	$(RW/PC)_{-1}$	dR	R^2	DW	RSE
Belgium	9.0 (9.0)		-1.16 (8.4)	1.29 (9.6)					0.89	1.03	13.5
	-	1.26 (8.1)	-2.23 (9.3)	1.08 (9.6)		-0.09 (12.0)			0.96	2.05	9.3
	-	1.15 (8.0)	-1.98 (8.2)	1.08 (10.6)		-0.08 (12.5)		-0.17 (1.5)	0.96	1.50	7.6
Denmark[2]	8.2 (3.5)		-0.76 (4.4)	0.84 (3.1)					0.54	2.19	20.4
	-	1.05 (4.0)	-1.43 (5.2)	0.63 (2.5)		-0.08 (2.9)			0.64	2.52	17.4
	-	0.73 (2.9)	-1.22 (4.2)	0.60 (2.4)			-0.06 (3.2)		0.66	2.62	16.6
Germany	7.6 (2.8)		-0.76 (2.2)		0.45 (2.0)				0.37	1.73	28.3
	-	0.82 (3.2)	-1.66 (2.6)		0.48 (2.6)	-0.07 (2.4)			0.45	1.90	26.2
	-	0.65 (2.6)	-1.66 (2.6)		0.46 (2.4)		-0.05 (2.3)		0.43	1.91	27.3
Netherlands	5.4 (1.9)		-0.88 (2.2)	0.40 (1.0)$^-$	0.59 (2.4)				0.75	1.62	19.6
	-	0.54 (1.5)	-1.38 (1.6)	0.49 (1.1)$^-$	0.60 (2.6)	-0.05 (1.6)			0.74	1.73	19.6
			-0.87 (2.4)	0.58 (1.5)$^-$	0.54 (2.4)			-0.48 (1.9)	0.79	1.60	17.1
United Kingdom	8.1 (2.1)		-0.75 (1.2)		0.70 (2.9)				0.30	1.46	40.8
	-	1.82 (3.5)	-2.72 (3.1)		0.51 (2.5)	-0.10 (1.7)			0.47	1.62	33.3
	-	2.03 (3.6)	-2.98 (2.6)		0.36 (1.6)		-0.05 (1.2)	-1.37 (1.6)	0.58	2.01	31.3
United States[2]	9.6 (4.7)		-0.96 (2.5)$^-$	0.27 (1.0)$^-$	0.35 (0.8)				0.68	2.57	15.0
	-	0.52 (2.3)	-0.68 (1.5)$^-$		0.62 (2.0)	-0.32 (2.2)			0.37	1.34	20.0
	-	0.21 (1.3)	-0.93 (2.3)$^-$		0.56 (2.1)		-0.20 (3.2)		0.53	1.59	17.5

1 Because of the relatively small number of observations and the fact that the estimates are based on annual figures, only one-period lags were tested. All equations were estimated without imposing homogeneity constraints and the variables were defined as follows:

w = percentage rate of change in total compensation per hour, BLS
U = rate of unemployment, national sources and definitions
p^e = expected rate of inflation, proxied by current or lagged actual changes in consumer prices, national sources
W = level of hourly compensation, index, BLS
PC = level of consumer prices, index, national sources
R = retention ratio, defined as personal taxes plus social security contributions (both employers' and employees') as a percentage of total employee compensation, Revenue and National Accounts Statistics, OECD
R^2 = coefficient of determination
DW = Durbin-Watson statistic
RSE = standard error of estimate as percentage of average value of dependent variable

t-statistics are given in brackets and a minus sign after the bracket or -1 indicates that a variable is entered with a one-year lag.

2 Since the unemployment equations for Denmark and the United States include an intercept shift (see Table 2) the wage equations were estimated allowing for a shift in the unemployment coefficient. In the case of Denmark unemployment was found to be insignificant for all three equations prior to 1976. For the United States the coefficients reported apply to the period 1972-82 while prior to 1972 they are -1.7, -1.1 and -1.6 respectively.

There is also clear evidence of tax-push effects in the United Kingdom and to a lesser extent in Belgium. In the Netherlands, changes in the tax rate have a significant impact on nominal wage changes when added to the Phillips curve but are insignificant when estimated in the context of the bargaining model.[1] The tax effects appear to be permanent in the United Kingdom, while in Belgium and the Netherlands they are mainly of a temporary nature, as the coefficient with respect to changes in tax rates is less than unity and the lagged level of post-tax earnings is far less significant than pre-tax earnings. In the case of Denmark and Germany inclusion of taxes provides only a marginal improvement, while for the United States real post-tax earnings are highly significant, although the overall fit remains less satisfactory than that of the Phillips curve. For all countries the tax variable includes personal as well as wage cost related taxes imposed on employers, so that the estimates do not permit a distinction to be made between the reaction of employees and that of employers.[2]

As regards the separate parameters, it can be seen that in the five countries where the real wage hypothesis found some support, the coefficient with respect to the rate of unemployment increases significantly (in absolute terms). This contrasts with earlier estimates (see above) and in some cases the coefficients obtained appear too high.[3] The sum of the coefficients on other nominal changes (prices)

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1 Similar results are reported in Knoester (1983).

2 It is conceivable that higher payroll taxes for the financing of social benefits are met by lower wage claims, thus dampening the effect of higher taxes on nominal wage changes and biasing the coefficient towards zero. A more remote possibility is that in countries with very progressive personal taxes wage-earners and unions have realised that higher nominal wage gains can lead to a reduction in post-tax real earnings.

3 This may be due in part to the suppression of the intercept term. In equations such as (i) and (iii) the intercept can be interpreted as including a time trend for nominal wage increases. By contrast, the underlying specifications of (iia and b) include a specific trend for the level of nominal wages. Suppressing the intercept term in these equations is, therefore, justifiable, although it necessitates some caution in interpreting the estimated parameters.

and/or lagged wages) falls significantly in Belgium, Denmark and the United Kingdom when lagged real wages are added, while in Germany and the Netherlands there are only marginal changes. Except for the Benelux countries, there appears to be some degree of real wage flexibility (i.e. wage bargaining takes place in nominal terms), but in assessing this finding the very crude approach and particularly the very simplistic expectation proxies should be kept in mind.

Equation (iii) yielded very unsatisfactory results as the coefficients on real wage costs and productivity were of the wrong sign and/or insignificant. This seems to confirm the suspicion expressed earlier that in the wider context of inflation models the impact of the real wage gap is ambiguous. By contrast, for all countries the real wage gap proved significant in the unemployment equations (see Table 2) although considering the lack of consistency of earlier estimates, this result ought to be interpreted cautiously.* In most countries the coefficient with respect to the output gap is around -0.3, implying that a one percentage point rise in the degree of output slack increases the rate of unemployment by about one-third of a point. A rise in the real wage gap of one percentage point increases the rate of unemployment by around one-third of a point in Belgium, Denmark, the Netherlands and the United Kingdom, but by less in Germany and, particularly, in the United States. In the case of Germany, Belgium and the United Kingdom, the

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* For both Denmark and the United States intercept dummies had to be included. For Denmark this implies an unexplained increase in the rate of unemployment of 5.3 points for the period 1976-82 and for the United States one of 2.2 points for 1972-82. This is, of course, a highly unsatisfactory estimation procedure, although in the case of the United States the shift may be due to rapid growth in the labour force, whereas for Denmark it is more likely to reflect a structural change or factors excluded from the specification.

Table 2 Unemployment equations.*

Countries	Constant	GNP GAP	GNP GAP$_{-1}$	WAGE GAP$_{-1}$	DUMMY	R^2	DW
Belgium	6.8	-0.27 (3.9)		0.33 (6.5)		0.84	0.68
Denmark	2.3	-0.27 (2.5)		0.30 (2.5)	-5.3 (7.8)	0.89	1.22
Germany	4.0	-0.28 (5.3)	-0.05 (0.9)	0.20 (11.9)		0.96	0.95
Netherlands	4.8	-0.37 (5.4)		0.35 (6.8)		0.88	1.93
United Kingdom	4.0	-0.29 (2.2)		0.35 (4.6)		0.75	0.94
United States	6.7	-0.43 (6.0)		0.06 (1.0)	-2.2 (6.8)	0.92	1.63

* In all equations the rate of unemployment (in percentages) is the dependent variable and the explanatory variables are defined as follows:
GNP GAP = percentage deviation of actual from trend output, 1965-81, OECD National Accounts
WAGE GAP = ratio between real wage costs (W/PO) and productivity (Q), log index, 1977 = 100
W = compensation per hour, BLS
Q = output per hour, BLS
PO = manufacturing value added deflator, OECD National Accounts and International Financial Statistics
DUMMY = 1 for 1965-71 and 0 for 1972-82 for the United States
1 for 1965-75 and 0 for 1976-82 for Denmark.

DW-statistic is very low, but for Belgium and the United Kingdom this problem disappeared when productivity and real wage costs were allowed separate coefficients. In all cases the real wage gap affects unemployment with a lag and the pattern of coefficients generally reflects the "openness" of the six countries.

Since the overall influence of output and real wage costs depends on both the estimated coefficients shown in Table 2 and on the actual developments (see Graph 2), Table 3 has been included as a further illustration. For different time periods the table shows the estimated contributions of changes in output and real wages as well as that part of the rise in unemployment which the equations are unable to explain. For the period 1966-74 unemployment increased moderately; this seems to have come about as the net result of a decline in the output gap (except in the United States), which, however, was not sufficient to offset the effect of a simultaneous rise in real wage costs (particularly strong in Belgium but also quite considerable in the Netherlands and the United Kingdom). For the period 1974-82 the picture is partly reversed.

Graph 2

Developments in unemployment, output and real wage costs.

——— Rate of unemployment, in percentages

——— Deviations of actual from trend GNP, in percentages

— — Wage gap (see Table 2), lagged one period

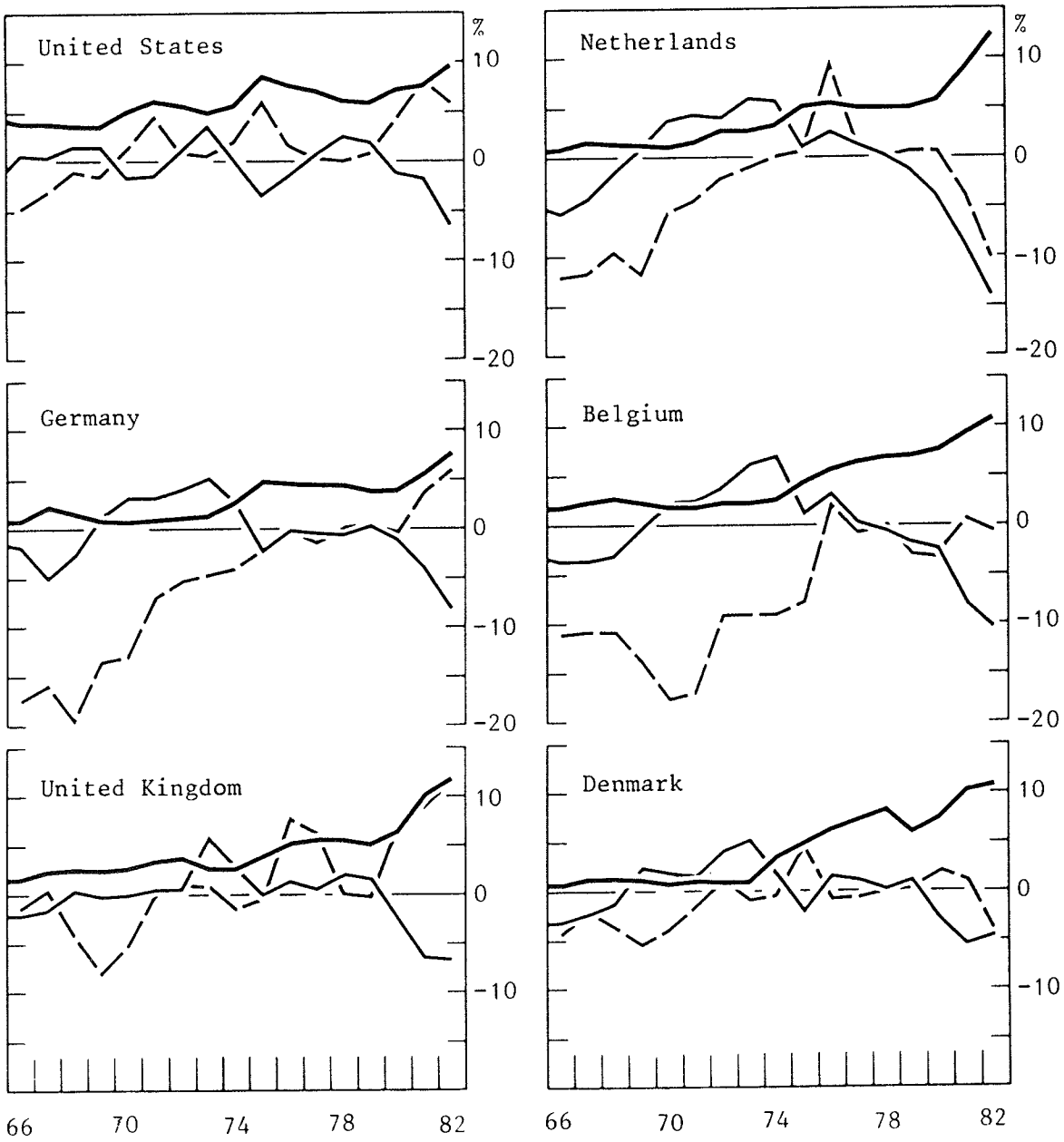

Table 3 Changes in unemployment, actual and by contributing factor.
(in percentage points)

Countries	1966-74				1974-82				1982-83			
	Actual	GNP	WAGES	Residual	Actual	GNP	WAGES	Residual	Actual	GNP	WAGES	Residual
Belgium[1]	0.6	-3.1	3.5	0.2	8.5	5.0	3.1	0.4	1.3	0.9	-0.4	0.8
Denmark	2.9	-1.3	1.2	3.0	7.4	1.7	-0.1	0.5[2]	0.9	0.2	-0.9	1.6
Germany	1.9	-1.6	2.7	0.8	5.0	3.4	2.0	-0.4	1.5	0.8	-0.4	1.1
Netherlands[1, 3]	2.5	-2.6	4.4	0.8	5.7	4.4	1.2	1.1	8.1	1.8	-0.6	6.9
United Kingdom[1]	1.1	-2.2	3.4	-0.1	9.1	4.2	3.0	1.9	0.7	-0.5	-0.6	1.8
United States	1.8	0.2	0.4	-0.8[2]	4.1	2.8	0.2	1.1	-0.1	-0.2	0.2	-0.1

1 Calculations based on unemployment equations with separate coefficients for real wages and productivity. 2 Including shift variables shown in Table 2. 3 The periods are: 1966-74, 1974-81 and 1981-83.

The output gap then widened in all countries, while the adverse effects of real wage cost developments were much smaller. As can be seen from the preliminary estimates for 1982-83,[1] this was particularly the case in recent years as in several countries moderate real wage growth and a fall in real wages relative to productivity prevented unemployment from rising further. When comparing the three sub-periods, two general observations may be made:

- much of the growth in real wage costs relative to productivity took place prior to 1973-74.[2] In several countries the first oil shock reinforced this trend but it was offset by real wage moderation later on. This has been evident in Denmark and the Netherlands and recently in Belgium and Germany as well. In the United Kingdom the real wage gap has also narrowed, but mainly owing to higher productivity growth, while

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1 1983 was not included in the estimation period and for some countries (especially the Netherlands) there is clear evidence of parameter instability in 1983 as well as 1982. This was further confirmed when the unemployment equations were estimated by ten-year overlapping regressions. In several countries the parameters remained relatively stable until 1981, but for the period 1972-82 they deviated sharply from earlier values and the R^2s declined.

2 See also Sachs (1979).

the United States has seen a continued rise in the real wage gap, although its influence on unemployment has been relatively small;[1]

- it is also interesting that during the period 1966-74 relatively strong output growth was not sufficient to offset the effect of rising real wages on unemployment, while during 1974-82 and especially in 1982-83 real wage moderation did not prevent growing output slack and rising unemployment. This suggests that neo-classical equilibrium conditions are of some importance for the sustainability of a given ouput growth path and that real wage moderation alone may not be enough to spark off a recovery of output.[2]

Turning to the price equations (Table 4), it may be recalled first of all that the influence of real wages on employment and unemployment depends on conditions in output markets and on firms' pricing behaviour: if firms are constrained by aggregate demand and set prices according to a mark-up on unit costs, real wages are unlikely to affect employment, while in the case of price constraints - which may be due to strong competition in international or domestic markets - real wages are more likely to play a rôle. Price equations can, therefore, provide some complementary information, and the estimates shown in Table 4 should be interpreted in this light.

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1 In this context it should be recalled that the estimates refer to manufacturing; there is some evidence that US firms have lost competitiveness in this sector. For the economy as a whole real wage costs have largely moved in line with productivity, and the aggregate real wage gap is small in comparison with other countries.

2 This may be further illustrated by a model developed by Lehment (1982) for Germany, whereby changes in the rate of capacity utilisation (dA) are explained by the difference between the rates of growth of nominal GNP (y) and nominal wages, and changes in employment growth (dB) are positively related to dA with a three-year distributed lag:

$$dA = 0.8\ (y - w) = 0.8\ (y/po - w/po) \text{ and}$$

$$dB = \sum_{0}^{2} a_i dA_{t-i} \qquad \text{with } \sum_{0}^{2} a_i \simeq 1$$

Between 1966-74 and 1974-82 average real wage growth for the aggregate German economy fell from 4.6 to 1.8 per cent., thus creating a potential for lower unemployment. However, between the same two periods average real GNP growth fell from 3.8 to 2.0 per cent., so that, including an "overhang" from 1966-74, employment actually declined.

Table 4 Price equations.[1]

Countries	Dependent variable	ulc	ulc_{-1}	exp/imp	exp/imp_{-1}	lagged dependent variable	Sum[2]	Average lag[3]	R^2	DW	RSE
Belgium	po	0.08 (0.6)	0.19 (2.0)	0.41 (5.3)	-	-	0.68	0.7	0.60	1.81	0.52
	pc	0.19 (3.0)	-	0.21 (5.9)	-	0.66 (2.3)	1.06	1.9	0.91	-	0.14
Denmark	po	0.34 (2.8)	-	0.07 (0.6)	0.54 (5.9)	-	0.95	0	0.78	2.02	0.20
	pc	0.28 (1.4)	0.55 (4.0)	0.26 (2.5)	-	-	1.09	0.7	0.62	1.08	0.29
Germany	po	0.46 (3.0)	0.22 (1.7)	0.09 (0.5)	-	-	0.77	0.3	0.58	2.37	0.58
	pc	0.18 (3.3)	-	0.06 (1.7)	-	0.73 (9.3)	0.97	2.7	0.78	-	0.19
Netherlands	po	-	0.29 (2.5)	0.32 (4.2)	0.20 (2.4)	-	0.81	1.0	0.59	1.84	0.43
	pc	0.22 (1.8)	-	0.08 (1.4)	-	0.72 (6.2)	1.01	2.6	0.31	-	0.28
United Kingdom	po	0.31 (2.6)	-	0.43 (3.0)	0.21 (1.7)	-	0.95	0	0.85	2.81	0.25
	pc	0.44 (5.7)	-	-	0.09 (1.6)	0.43 (5.1)	0.96	1.3	0.83	-	0.21
United States	po	0.30 (3.1)	0.24 (2.1)	-	0.28 (2.8)	-	0.82	0.5	0.83	2.10	0.28
	pc[4]	0.30 (3.6)	-	-	0.08 (3.0)	0.70 (11.0)	1.07	2.3	0.93	-	0.12

1 Notation:
po = percentage change in value added deflator for manufacturing, OECD National Accounts
pc = percentage change in consumer prices, CPI-indices, national sources
ulc = percentage change in unit labour costs, BLS
imp = percentage change in import prices, OECD National Accounts
exp = percentage change in export prices, OECD National Accounts
RSE = standard error in percentage of average value of dependent variable.

2 Sum of coefficients with respect to explanatory variables.

3 Defined with respect to ulc.

4 Coefficients of 0.46 (4.4) with respect to current level of output slack not shown.

To facilitate comparisons, the same specification was used for all countries and for both price indices the number of explanatory variables was kept small. Nonetheless, certain interesting features are revealed and there is cogent evidence that manufacturing firms are facing some measure of price constraint:

- in most countries the coefficient with respect to export prices in producer price equations is larger than that of unit labour costs and also exceeds the estimated impact of import prices on consumer prices. Exceptions are Denmark and Germany, where the influence of export prices appears to be understated. For the United States, on the other hand, the impact of export prices, although smaller than that of unit labour costs and occurring with a lag, clearly exceeds the share of exports in manufacturing output;

- the sum of coefficients with respect to explanatory variables (see column 6 of Table 4), which may be interpreted as the long-run mark-up, is in all countries lower for producer prices than for consumer prices, and in some cases (especially in Belgium but also in Germany, the United States and the Netherlands) it is below unity, suggesting that cost increases are not fully passed on to prices;

- the average lags tend to be much longer for consumer prices than for producer prices. This implies, of course, that the two indices will deviate in the short run, but it may also be indicative of a strong influence of seller/customer relationships on consumer prices, whereas producer prices are more exposed to the volatility of market forces.

Finally, Graph 3 combines the results from Tables 1, 2 and 4 in a set of simulations, with the purpose of showing how the assumption of an endogenous unemployment rate creates a link between wage increases and labour-market conditions which serves to "anchor" the inflation process. Purely as an illustration, the simulations start from a permanent percentage point reduction in output slack and then present the subsequent changes - relative to the initial year - in nominal wages, unemployment and real wage costs. For the United States and the Netherlands the calculations are based on the expectations-augmented Phillips curves, whereas for the other countries the wage equations including the effect of lagged real pre-tax earnings have been used. In all cases it has been assumed that, initially, real wage costs equal productivity and that the latter is unaffected by a lower level of output slack.

As might be expected, the graph shows a marked difference between the United States, on the one hand, and some of the smaller and open European economies, on the other:

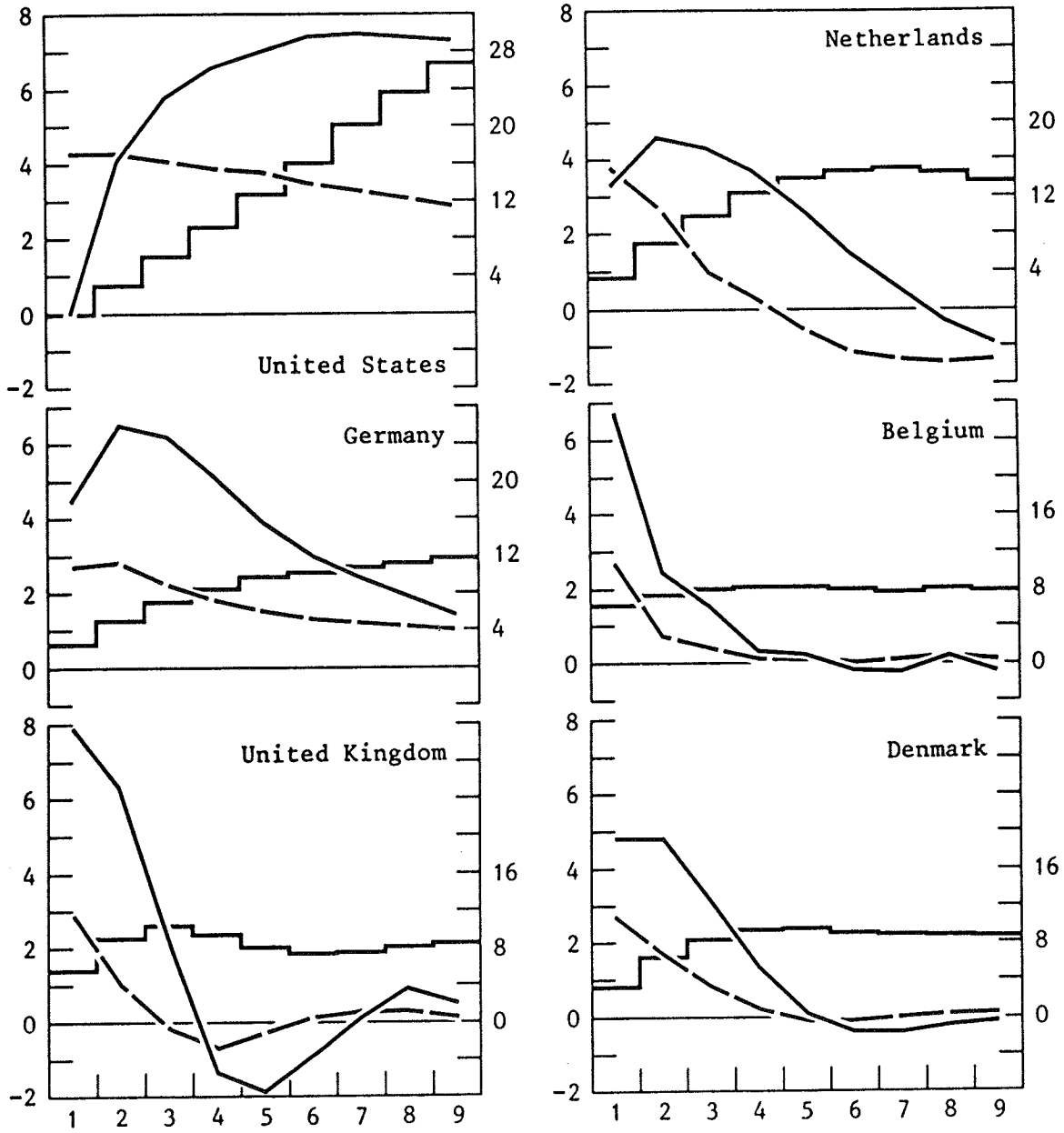
Graph 3

Simulated effects of lower output slack*

— — change in the rate of unemployment with sign reversed (1,h,s)

——— change in the rate of nominal wage increases (1,h,s)

—⌐— change in the level of real wage costs (r,h,s)



*Simulations are based on a 10 percentage point reduction in the output gap, using the equations shown in Tables 1,2 and 4, except that for the United States the effect of a lower output gap on consumer prices has been ignored. All changes are measured in percentage points relative to the initial situation.

- in the United States, where real wage costs have only a small effect on the rate of unemployment and real earnings do not influence current wage claims, lower output slack leads to a marked rise in employment and real earnings but also to a worsening of inflation. Indeed, the rate of nominal wage increases continues to accelerate until eight years after the demand stimulus[1] and even at the end of the simulation period the rate of unemployment is 3 percentage points below the initial rate, while the level of real earnings is 16 per cent. higher;[2]

- for most of the other countries, the rise in employment and inflation is only temporary, as higher real wage costs partly or wholly offset the stimulus to employment, while increasing unemployment together with a dampening influence of higher real earnings bring nominal wage increases back to the initial rate or even below. As a result, the major effect of the reduction in output slack is an improvement in real earnings for the employed labour force.

However, the simulations also underline the limitations of a model consisting of only four equations. This is most clearly evident in the case of the United States, where the situation at the end of the simulation period would appear to be unsustainable, with both the rate of inflation and the level of real wage costs being much higher than initially.[3] In other words, the higher rate of inflation combined with the lower profit share is bound to have repercussions, which, however, do not show up in the simple model used here.

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1 A demand stimulus, however, does not induce a permanent acceleration of inflation, as the US wage equation (see Table 1) implies that wage-earners are subject to some degree of money illusion.

2 Except for Germany, the rise in real earnings is in all countries considerably below that of real wage costs, because consumer prices are more strongly influenced by unit labour costs than producer prices.

3 In this context it should also be noted that while the real wage changes observed for the five European countries are well within the range of actual changes over the period 1966-82 those shown in the graph for the United States go considerably beyond what has been seen in the past.

The simulations also point to rather large differences between the European countries, and it is clearly too much of simplification to talk about a "European case" versus a "United States case". Thus in the United Kingdom, Belgium and Denmark the acceleration in nominal wages very quickly subsides as wage pressures are reduced by higher unemployment as well as by rising real earnings. In the Netherlands, nominal wage increases remain high over a longer period, since there is no dampening effect of real earnings and the rate of unemployment has to increase 1½ percentage points above its initial level before nominal earnings growth stabilises. Finally, Germany appears to occupy an intermediate position, as by the end of the simulation period both employment and real earnings are higher than initially while the rate of nominal wage increases has accelerated far less than in the United States. This outcome can be ascribed to a combination of several factors, including a small impact of real wage costs on unemployment, a high elasticity of producer prices with respect to changes in unit labour costs, and a nominal wage equation which is sensitive to both labour-market conditions and real earnings.

IV. Conclusions

This paper started out by summarising the main features of an expectations-augmented Phillips curve with accompanying mark-up price equations. The empirical counterparts for six countries were presented in Section III; even though preliminary, they were relatively satisfactory in terms of statistical fit and a priori expectations with respect to the sign and size of the parameters.

However, in periods when both inflation and unemployment have increased far above historical trends, it is somewhat unsatisfactory to assume that the level of unemployment is exogenous and independent of the inflation process. Moreover, considering the simultaneous changes in relative prices and real wages there would seem to be some merit in incorporating these variables - directly or indirectly - in the wage formation process.

One possibility in this respect is to focus on the employees' side and assume that wage-earners have certain targets with respect to pre-tax or post-tax real earnings. This introduces the lagged level of real earnings as an argument in the wage equation, and it was found to give significantly or marginally better results in five countries, but not in the United States. Moreover, in three countries there is clear evidence of tax-push effects, though the extent to which wage-earners seek full compensation for tax increases differs between the three countries, being strongest in the United Kingdom and only temporary and incomplete in Belgium and the Netherlands.

This approach gives a more satisfactory explanation for the rise in nominal wage increases than the expectations-augmented Phillips curve, and it can in part explain the instability of the latter. However, it does not account for the simultaneous rise in unemployment, nor does it guarantee that the real wage target is compatible with equilibrium in the labour market. Indeed, if the real wage target exceeds labour productivity, realisation of the target will produce a widening discrepancy between real wage costs and productivity and a declining profit share which sooner or later is likely to affect employment and unemployment.

Consequently, as a second alternative, the labour demand side was considered, firstly by adding a real wage gap measure to a traditional Phillips curve, and secondly by assuming that employers' reaction to high real wages is more likely to be observed in labour demand than in the rate of wage inflation. This indirect approach produced by far the most satisfactory results, as in all countries the real wage gap was found to have a significant impact on the rate of unemployment, thereby creating a link between the inflation process and underlying labour-market equilibrium conditions.

Although the estimation procedures and specifications are rather crude, these findings support the view that the wage/unemployment relationship should be interpreted as a "two-way" process. This, in turn, suggests three final observations.

Firstly, the integration of employment or unemployment functions in the Phillips curve implies that real wage rigidity on the part of wage-earners does not have the same consequences as when the inflation process is considered in isolation. While for some of the countries it would be possible to derive a rate of unemployment where inflation is stable, such a rate is meaningless when unemployment is influenced by real wages. In these conditions an attempt to reduce the level of unemployment through demand expansion would not lead to ever-accelerating inflation but - with some lag - to rising unemployment, as the level of real wages relative to productivity acts as a kind of "built-in stabiliser" with respect to inflation. The strength of this stabiliser depends on the extent to which firms are facing price constraints, which, in turn, is a function of the share of foreign goods and the exchange rate and monetary policies adopted.* Thus there is still a limit to how far the unemployment rate can be reduced but it is mainly determined by profitability conditions.

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* If, for instance, exchange rates are flexible and largely follow purchasing power parities, price constraints are less likely to occur. On the other hand, a tight monetary policy could make it more difficult to shift higher costs into prices.

Secondly, this "two-way" process can also be observed in major trends over the last 16-17 years (see Graph 2), which may be used in explaining shifts in the Phillips curve and in deriving certain tentative policy implications:

- the period prior to the first oil shock was characterised by rapid output growth, falling profit shares and a gradual worsening of both inflation and unemployment (i.e. an upward and outward shift of the Phillips curve). Whereas the acceleration of inflation can in part be explained by growing demand pressures, the rising level of unemployment in the face of strong output growth may be seen as a response to the widening discrepancy between real wage costs and productivity;

- by contrast, the period since 1974 saw a marked slowdown in output growth and - after a further worsening in the wake of the first oil shock - some improvement in profit shares owing to a more moderate real wage behaviour. Because of the widening output slack unemployment has increased sharply, but there are, at the same time, indications that underlying labour-market conditions have improved and that the Phillips curve has shifted downwards.[1]

By comparing the two sub-periods the conclusion may be drawn that expansionary policies unaccompanied by wage moderation are unlikely to lead to a sustainable growth path, and this will manifest itself in a worsening Phillips curve. For the second sub-period it remains to be seen whether the moderation in real wages is of a permanent nature. Nonetheless, judging from recent developments it also appears that wage moderation unaccompanied by supporting aggregate demand policies does not spark off a self-sustaining recovery process. Hence, corresponding to the "two-way" wage/unemployment nexus, there is a "two-way" policy implication.[2]

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1 Most Phillips curves based on past behaviour tend to overpredict current rates of inflation. See also Perry (1983), who provides evidence that the "norm rate" of wage inflation has declined.

2 See also Budd and Dicks (1984).

Thirdly, even though the empirical estimates justify the above tentative conclusions, they also leave several questions and some areas for future research:

- unemployment in some of the European countries has recently increased far more than the equations predict, implying that additional forces may have been at work or that the parameters are unstable. The US equations, on the other hand, are quite satisfactory when seen in isolation, and there is little evidence that real wage rigidity has been a major cause of unemployment. Nevertheless, the simulations suggest that certain "built-in" stabilisers are missing and that a wider model framework is required;

- the distinction between output and real wage induced changes in the level of unemployment should also be interpreted cautiously. The empirical evidence does not reject this distinction, nor are the estimated coefficients inconsistent with a priori expectations based on the openness of the countries concerned. Nonetheless, changes in real wage costs and output are not independent of each other and policy actions frequently affect aggregate demand as well as the level of real wages;

- the sharp rise in real wage costs (and the corresponding fall in profit shares) towards the end of the 1960s and in the early 1970s is puzzling as there are no apparent reasons why producers were unable to raise output prices in line with unit costs. During most of this period, aggregate demand was buoyant and both fiscal and monetary policies were relatively expansionary. Lags in the adjustment of prices can explain some fall in profit shares, particularly in periods of sharply accelerating unit costs, but they cannot explain the suppressed level of profits throughout most of the 1970s;

- finally, the influence of monetary policy on firms' employment and pricing behaviour needs further analysis, both with respect to direct effects and regarding actual or expected exchange rate movements. It is conceivable that the move towards more flexible exchange rates and the adoption of aggregate targets in some countries have been conducive to a classical régime, with real wages having a stronger influence on the demand for labour. To the extent that this has occurred the restrictive policies pursued in recent years may go some way towards explaining

the sharp rise in unemployment, since, apart from slower aggregate demand growth, the adverse impact of high real wages would be higher.* By the same token, such policies would have increased the potential stimulus of wage moderation and thereby improved the outlook for achieving sustainable growth. However, it needs to be explored whether these relationships are supported by the empirical evidence and this would seem a most important subject for future research in this area.

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* In his empirical estimates Sachs (1983) includes the real money stock as a measure of aggregate demand, but in discussing the empirical results he also allows for more indirect effects of monetary policy, particularly through exchange rate fluctuations.

Annex I The Phillips curve framework

The wage and price formation process contained in most macro-economic models may be summarised in a three-equation model:

$$(i) \qquad w_t = a - b\,U_t + c\,p_t^e$$

$$(ii) \qquad p_t = d\,(w_t - \bar{q}) + (1-d)\,px_t$$

$$(iii) \qquad p_t^e = \sum_{i=1}^{\infty} \alpha_i\, p_{t-i} \qquad \text{with} \sum_{1}^{\infty} \alpha_i = 1$$

where w = percentage change in nominal wages

p = percentage change in prices

$\bar{q}$ = percentage change in trend productivity

px = percentage change in external prices

U = rate of unemployment, percentage

e = expected value

t = time.

All parameters are positive, and in the wage equation c indicates the degree of money illusion on the part of wage-earners. The price equation is homogeneous with resp-ct to domestic and external input costs, while cyclical factors do not play any rôle. Finally, inflationary expectations are formed adaptively, and if the expected price change for year t only depends on the lagged price change, the model may be reduced to one equation with nominal wages as the dependent variable:

$$(i') \qquad w_t = a - b\,U_t - cd\,\bar{q} + c\,(1-d)\,px_{t-1} + cd\,w_{t-1}$$

This is a first-order difference equation* which is stable and convergent for $cd < 1$; i.e. disturbances to the system in the form of changes in U, px and $\bar{q}$ will lead to fluctuations in the rate of nominal wage increases but the latter will eventually approach a constant and stable rate. In most models cd is well below unity, but it is worth noting that this

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* The equation will normally be of second or higher order because of lags.

result depends on the behaviour of both wages and prices. Thus the absence of money illusion (i.e. c = 1) does not lead to an unstable system as long as d < 1, and the latter will usually be the case when some input costs are determined externally.[1]

Another feature of the above model is that as long as external prices increase at the same rate as domestic prices, real wages will in the long run rise in step with trend productivity growth, regardless of the level of unemployment and the degree of money illusion.[2] Thus, for $px_t = p_t$, equation (ii) reduces to

$$(ii') \qquad p_t = w_t - \bar{q} \qquad \text{or} \qquad w_t/p_t = \bar{q}$$

and this result occurs because any change in either nominal wages or productivity is fully passed on into prices. If, on the other hand, the mark-up, owing to various constraints, is less than 100 per cent., the price equation does not satisfy the homogeneity condition and the pattern of real wage changes can easily differ from that of productivity, leading to shifts in the distribution of factor income.

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1 See Pitchford (1981) for a good discussion of this point.

2 If price changes were also influenced by cyclical factors, real wage increases would no longer be independent of the rate of unemployment but would be a function of the relative cyclical sensitivities of wages and prices. The degree of money illusion, on the other hand, merely affects the speed with which the long-run relationships are being established and the rate of nominal inflation associated with a given change in real wages. Thus, consider equation (i') in the case of $px_{t-1} = w_{t-1} - \bar{q}$ and assume a permanent decline in $\bar{q}$. It is easily seen that for c = 1 there is a permanent increase in w_t which is identical to the decline in productivity growth, while in the opposite extreme of c = 0, w_t remains constant.

Annex II The bargaining model with various adjustment schemes

The basic idea of the bargaining model is that current wage claims (W) are set with respect to certain targets for post-tax real income (W^*). However, wage-earners are not assumed to aim for an immediate closing of the gap between actual and target real wages, and the rate of unemployment may modify the target and/or the speed of adjustment. Assuming a partial adjustment scheme (with λ denoting the fraction of the gap which wage-earners try to close in one period), letting capital letters denote variables in level form and small letters rates of change, and otherwise maintaining the notation used in the text, Sargan's hypothesis may be expressed as follows:

(i) $$(R \cdot W/P^e)_t = (W^* \, U^b)^{\lambda} \, (W \cdot R/P)^{1-\lambda}_{t-1} \qquad \text{or}$$

(ii) $$w_t = -\lambda b \log U_t + \lambda \log W^* - \lambda \log (R \cdot W/P)_{t-1} + \log (P^e/P_{t-1}) - \log (R_t/R_{t-1})$$

where the second equation has the change in nominal wages as the dependent variable.

There are, however, certain specification problems.* In particular, it is a question whether the wage adjustment process is subject to nominal or real wage

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* Instead of using a partial adjustment scheme, one may also start from the general assumption:

$$W_t = W^* + P_t$$

where W and P are log-levels of wages and prices, W^* the real wage target and U and R are ignored. Introducing a general lag-scheme:

$$\alpha(L)W_t = W^* + \beta(L)P_t$$

but restricting it to first order, an estimating equation may be derived as:

$$W_t = W^* + \beta_0 P_t + \beta_1 P_{t-1} - \alpha_1 W_{t-1}$$

In order to obtain the initial equation, the coefficients would need to satisfy the restrictions:

$$\beta_0 + \beta_1 - \alpha_1 = 1$$

and imposing this restriction, the estimation equation becomes:

$$W_t = W^* + \beta_0 P_t + \beta_1 P_{t-1} + (1 - \beta_0 - \beta_1) W_{t-1} \qquad \text{or}$$

$$w_t = W^* + \beta_0 p_t - (\beta_0 + \beta_1) (W - P)_{t-1}$$

which makes the rate of change in nominal wages a function of the real wage target, the current rate of price change, and the lagged level of real wages. While this result is identical to that obtained from a partial adjustment scheme applied to nominal wages (see below), second and higher-order lags can be introduced, providing a potentially much richer specification which through appropriate restrictions on the coefficients would still satisfy the initial equation. For further discussion of this procedure (usually referred to as the "Error Correction Model") see Davidson et al. (1978) and Currie (1981).

rigidity* and in this respect, four cases may be distinguished, with each of them implying different a priori values for the influence of price expectations.

(a) Nominal wage rigidity: Letting W_N^* denote the wage target in nominal terms, ignoring the retention ratio, and assuming $W_N^* = W^* P^e U^{-b}$, the case of nominal wage rigidity may be shown as:

(iii) $$\log W_t = \lambda \log W_N^* + (1 - \lambda) \log W_{t-1}$$

i.e. nominal wages adjust partially to the nominal wage target, with λ denoting the speed of adjustment. Inserting the equation for W_N^* and assuming $\log P_t^e - \log P_{t-1} = p_t^e$, gives

(iv) $$w_t = \lambda \log W^* - \lambda b \log U_t + \lambda p_t^e - \lambda \log (W/P)_{t-1}$$

where the coefficient with respect to p^e is seen to be positive but less than unity.

(b) Real wage rigidity: The partial adjustment function is now assumed to be:

(v) $$\log (W/P^e)_t = \delta \log (W_N^*/P^e) + (1 - \delta) \log (W/P)_{t-1}$$

and inserting the definition of the nominal wage target yields:

(vi) $$w_t = \delta \log W^* - \delta b \log U_t + p_t^e - \delta \log (W/P)_{t-1}$$

where the a priori value for the coefficient on p^e is unity.

(c) General case: Combining equations (iv) and (vi) leads to a more general case which in terms of the initial partial adjustment function may be presented as:

(vii) $$\log W_t = \mu_1 \log W_N^* + (1 - \mu_1) \log W_{t-1} + \mu_2 \log (P^e/P_{t-1})$$

where μ_1 and μ_2 are assumed to be between zero and unity. Inserting the equation for the nominal wage target yields:

(viii) $$w_t = \mu_1 \log W^* - \mu_1 b \log U_t + (\mu_1 + \mu_2) p_t^e - \mu_1 \log (W/P)_{t-1}$$

where the coefficient with respect to p^e is positive, higher than in case (a), but below unity.

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* See, in particular, Branson and Rottemberg (1981).

(d) Canadian case: The following wage adjustment equation was a main feature of the Canadian RDX2-model (see Freedman (1977)):

$$\text{(ix)} \qquad \log (W_t/P_{t-1}) = \lambda \log (W_N^*/P^e) + (1 - \lambda) \log (W/P)_{t-1}$$

or in terms of nominal wage changes:

$$\text{(x)} \qquad w_t = \lambda \log W^* - \lambda b \log U_t - \lambda \log (W/P)_{t-1}$$

where the a priori coefficient on price expectations is zero.[1]

This last case may also be used to illustrate an important difference in relation to the expectations-augmented Phillips curve.[2] Thus, setting $\lambda = 1 - c$ and rewriting equation (x) as

$$\text{(xi)} \qquad \log W_t = (1-c)\, W^*_t - (1-c)\, b \log U_t + c \log W_{t-1} + (1-c) \log P_{t-1}$$

one obtains by continuous substitution:

$$\text{(xii)} \qquad \log W_t = (1-c) \sum_{i=0}^{\infty} c^i \log W^*_{t-i} - (1-c)\, b \sum_{i=0}^{\infty} c^i \log U_{t-i} + (1-c) \sum_{i=1}^{\infty} c^i \log P_{t-}$$

where the last term would be identical to P^e_t assuming that expectations with respect to the price level are formed according to an adaptive scheme.

On the further assumption that W^* follows a trend, equation (xii) in first-order form can be written as:

$$\text{(xiii)} \qquad w_t = a - (1-c)\, b \sum_{i=0}^{\infty} c^i \Delta \log U_{t-i} + p^e_t$$

which is similar to an expectations-augmented Phillips curve with no money illusion, except that changes in nominal wages are determined by a weighted average of past changes in the rate of unemployment rather than by the current (or lagged) level. It is also interesting to note that even though expectations were excluded from the initial equation (ix), they reappear with a unit coefficient once the term in lagged real wages has been eliminated.

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1 In the text, the actual size of the expectation coefficient is decided by the empirical estimates, but it might be noted that when the coefficients are less than unity (or the equation is non-homogeneous in nominal changes) the long-run level of real wages will depend on the long-run rate of price inflation. For a further discussion of this issue and of various ways of constraining the coefficients to satisfy static as well as dynamic equilibrium conditions, see Currie (1981).

2 See also Freedman (1977).

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