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IS THERE A NAIRU IN NORWAY?*

by

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ABSTRACT

Unemployment in Norway stayed at a rather low level both in the sixties and the seventies. In the same period Norwegian manufacturing industries lost competitiveness. A lower rate of unemployment than the equilibrium rate, which misleadingly often is called the nonaccelerating inflation rate of unemployment (NAIRU) may be an important reason for this. During the eighties there was considerably higher unemployment while the loss in competitiveness continued. This may indicate an outward shift in the Phillips curve, implying an increase in the equilibrium rate.

Two interpretations of a rising equilibrium rate have been offered in the economic literature. The "structuralists" emphasize increasing structural problems in the economy. The "hysteresis" approach posits an equilibrium rate that automatically follows in the path of the actual rate of unemployment. This paper investigates the existence of rising structural problems and hysteresis effects in the Norwegian labour market.

1. INTRODUCTION

Unemployment in Norway stayed at a rather low level both in the sixties and the seventies. In the same period Norwegian manufacturing industries lost competitiveness. A lower rate of unemployment than the equilibrium rate, which misleadingly often is called the nonaccelerating inflation rate of unemployment (NAIRU) may be an important reason for this. During the eighties there was considerably higher unemployment while the loss in competitiveness continued. This may indicate an outward shift in the Phillips curve, implying an increase in the equilibrium rate.

Chapter 2 gives a theoretical background for the concepts of the equilibrium rate and NAIRU. The term NAIRU may seem misleading, since a lower rate of unemployment than the equilibrium rate should only increase inflation and not accelerate it (but accelerate the price level). The term "non increasing inflation rate of unemployment" (NIIRU) would therefore be more appropriate. Another point is that while the equilibrium rate and NIIRU may be used synonymously in a closed economy this is not obvious for a small, open economy. This is of importance when evaluating estimated values of NIIRU in actual economies.

It has been claimed that NIIRU has increased in most western countries during the last decade. Two interpretations of a rising NIIRU have been offered. The "structuralists" emphasize increasing structural problems in the economy. On the other hand the "hysteresis" approach posits a NIIRU that automatically follows in the path of the actual rate of unemployment. This approach has become popular in the later years, and three types of explanations referred to as the "physical capital", "human capital" and the "insider/outsider" stories are outlined in chapter 2.

By analysing the mismatch between vacant jobs and unemployment and the composition of unemployment, the change in structural problems in the Norwegian labour market is investigated in chapter 3. Tests of hysteresis versus Phillips curves are carried out in chapter 4 by estimating wage equations for the Norwegian manufacturing industries. A change in the effect from unemployment on wage formation between different periods of estimation may indicate a change in the equilibrium rate.

2. THEORETICAL BACKGROUND

2.1. The Phillips curve and the natural rate of unemployment

The term "equilibrium rate of unemployment", often used synonymously with the "nonaccelerating inflation rate of unemployment (NAIRU)", descends from the works of Phelps (1967) and Friedman (1968) and have close connections with the Phillips curve. This curve states a negative relation between the rate of change in the average level of money wages and the aggregate rate of unemployment and is based on empirical observations from the United Kingdom presented by Phillips (1958). Lipsey (1960) and Hansen (1970) have later on formalized the Phillips curve based on the classical theory of price dynamics; shifts in demand or supply for labour may in the short run cause disequilibrium in the labour market, but changes in wages will then tend to move the economy back to equilibrium.

Both Lipsey and Hansen point out that the labour market consists of different submarkets with different excess demand as a result of structural changes and imperfect mobility of labour between the submarkets. This means that unemployment and vacancies coexist. At some level of unemployment there is then an equilibrium where wages tend to rise at a "normal" rate due to increasing prices and productivity. A lower level of unemployment is an indication of excess demand for labour which will cause an upward pressure on wages. Friedman (1968) denotes this equilibrium rate of unemployment the "natural" rate. This is however not a good expression as there is nothing "natural" about it. Friedman pointed out that the equilibrium rate of unemployment may depend on structural characteristics of both labour and commodity markets. A change in these characteristics may change the equilibrium rate.

Both Phelps (1967) and Friedman (1968) argue that price expectations ought to be included when explaining nominal wage growth because the Walrasian system of general equilibrium determines relative and not absolute prices. When we also include the growth in productivity influencing the growth in real wages, the Phillips curve may be written as

$$(2.1) \quad \frac{\Delta W}{W} = g(U) + \frac{\Delta P^e}{P} + \frac{\Delta Z}{Z}$$

where W denotes nominal wage rates
P actual price level
P^e expected price level
Z productivity
U the rate of unemployment

Phelps and Friedman argue further that except from instant shocks people may know the functioning of the economy. With rational expectations and an adjustment for the growth in productivity the expected growth in prices may be written as

$$(2.2) \qquad \frac{\Delta P^e}{P} = \frac{\Delta P}{P} = \frac{\Delta W}{W} - \frac{\Delta Z}{Z}$$

Inserted in (2.1) this gives

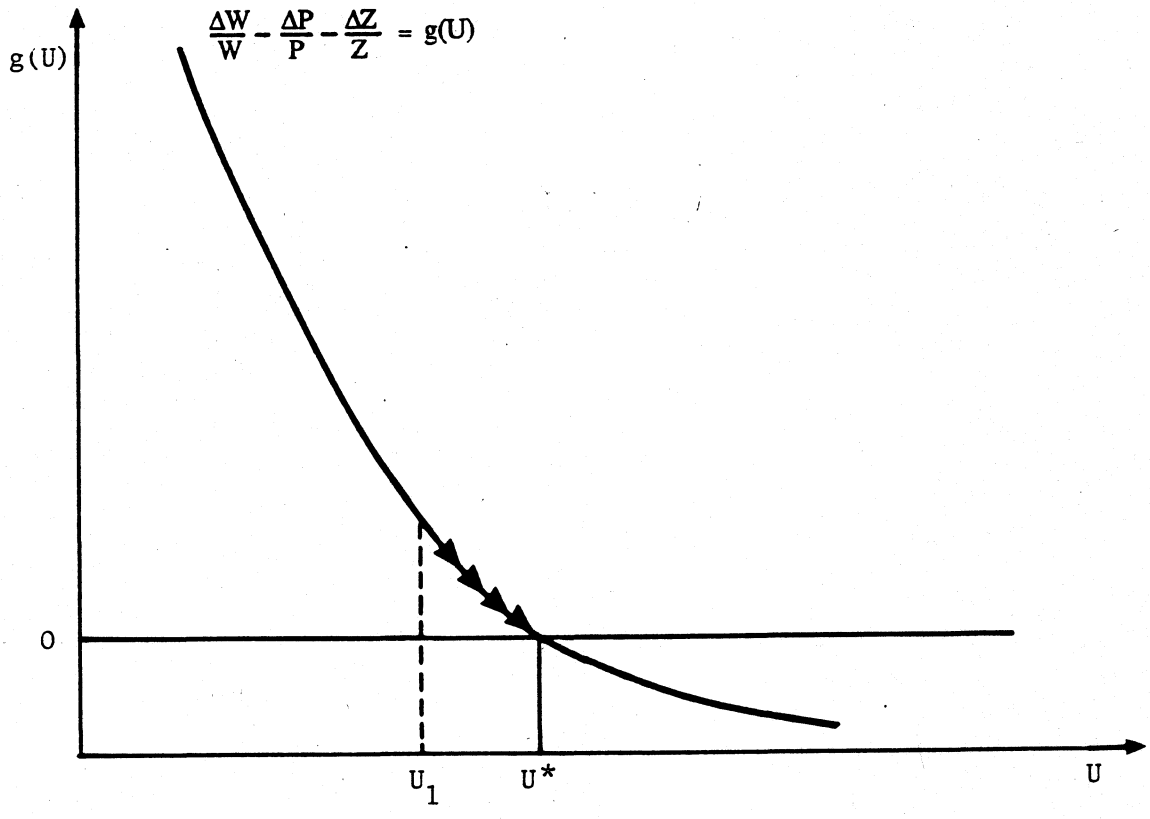
$$(2.3) \qquad g(U) = 0$$

which defines the equilibrium rate of unemployment.

The situation may be as illustrated in figure 2.1 where the equilibrium rate of unemployment is denoted by U^*. An expansive financial policy which aims at reducing the rate of unemployment below the equilibrium rate may succeed in the short run reducing unemployment to U_1. At U_1 there exists excess demand for labour and this will cause a growth both in nominal and real wages which tend to decrease supply of products and demand for labour. After a while unemployment returns to its equilibrium rate, and in the long run the Phillips curve is vertical at U^*.

The unemployment can be kept below the equilibrium rate only by inflation, but in the simple reasoning here not necessarily by accelerating inflation as claimed by Friedman. However, a continually worsening of the government's budget and a shrinking private sector in the case of expansion in government employment put limits to the sustainability of this policy. If the expansive policy is financed by printing money, it may be necessary to accelerate the printing and thereby the price level to keep unemployment below the equilibrium rate. In this context the term equilibrium rate should be used synonymously with the "non increasing inflation rate of unemployment" (NIIRU) while the term NAIRU is misleading.

Figure 2.1. The Phillips curve and the equilibrium rate of unemployment



As pointed out by both Friedman (1968) and Santomero and Seater (1978) the equilibrium rate is determined by real factors like the degree of mobility in the labour market, structural changes, speed of information, institutional arrangements affecting wage bargaining and the power of the trade unions. According to this structuralist view, the equilibrium rate of unemployment may change if some of these factors change.

2.2. Hysteresis in the equilibrium rate

An alternative approach discussing the variability in the equilibrium rate of unemployment which has become popular the last decade, is the concept of hysteresis. The term hysteresis literally means what comes after, or behind, and in a historical overview Cross and Allan (1988) point out that the term was coined for application to phenomena in the science of physics. A characterizing feature of a system in which hysteresis is postulated is that the behaviour of the system cannot be explained by reference

to current levels of state variables alone. The past history of the system also has to be included.

Phelps (1972) was the first to suggest that the equilibrium rate of unemployment could well be haunted by hysteresis because it partly could be determined by the actual unemployment experienced during the transition from one steady state of inflation to another. In recent years aspects of hysteresis in the labour market have been discussed among others by Hargreaves Heap (1980), Coe (1985 and 1988), Blanchard and Summers (1987 and 1988) and Cross (1987). Three types of explanations which loosely speaking might be referred to as the "physical capital", the "human capital" and the "insider-outsider" stories can explain why shocks causing unemployment in one period may have long term effects on the equilibrium rate of unemployment.

The physical capital argument is based on the works by Sneessens (1983) and Drèze and Sneessens (1986). They present a macroeconomic disequilibrium model where price and wage adjustments are not sufficient to clear the goods and the labour markets at each moment of time. Actual employment may be determined either by a sales constraint (Keynesian unemployment), by a capacity constraint (classical unemployment) or by a labour supply constraint (repressed inflation).

Based on empirical estimates of their disequilibrium model for Belgium Drèze and Sneessens find that total unemployment may be decomposed in factors according to structural mismatch, insufficient demand and capital gap. An increase in demand would then not be sufficient to eliminate unemployment without creating inflationary pressure. Creation of additional capacity and better adjustment of supply to demand would also be necessary to eliminate unemployment. Because it takes some time to create additional capacity, it may be difficult to get a substantial decrease in unemployment by increasing demand without creating inflation, and the equilibrium rate of unemployment where wages tend to increase at a normal rate according to prices and productivity may have increased because of reduced production capacity during a recession.

Blanchard and Summers (1988) seem to be somewhat sceptical to the argument that some part of unemployment may be explained by lack of capacity. They point out that substantial reduction of capacity during the 1930s did not preclude the rapid recovery of employment associated with rearmament in a number of countries. Neither did the substantial reduction in the size of the civilian capital stock that occured during the war prevent the

attainment of full employment very soon after the war.

The second mechanism which may explain hysteresis is loss of human capital among the long-term unemployed, and some people may also leave the labour force. This argument may be found in Phelps (1972) and Hargreaves Heap (1980). The human capital argument holds that workers who get unemployed loose the opportunity to maintain and update their skills by working. Particularly for the long-term unemployed loss of skills may make it difficult to get a new job because the employers may regard them as unsuitable for employment. An increasing number of long-term unemployed may then increase the wage pressure for a given total number of unemployed. As the number of long-term unemployed normally is positively correlated with the level of unemployment the equilibrium rate of unemployment may increase if there is an increase in the actual rate. If so, changes in unemployment may be a better explanatory factor for changes in real wages rather than the level of unemployment as suggested by the traditional Phillips curve.

Because there may be some lags from the change in the actual rate of unemployment to the equilibrium rate, Coe (1985 and 1988) suggests a specification of the form

$$(2.4) \quad \Delta w_t / w_{t-1} = \beta_0 - \beta_1 U_t + \beta_2 U_t^*$$

where w_t denotes real wages, and U_t^* is defined as a distributed lag on past values of U_t. A significant positive estimated coefficient on U_t^* of roughly the same size as β_1 would then be an indication of hysteresis in the equilibrium rate. According to the argument about loss of human capital among the long-term unemployed, Coe (1988) also suggests that the development in U^* in (2.4) could be approximated by the rate of long-term unemployment. Letting U^L and U^S be the long- and short-term rates of unemployment and approximating U^* by U^L, (2.4) can be written as

$$(2.5) \quad \Delta w_t / w_{t-1} = \beta_0 - \beta_1 U^S + (\beta_2 - \beta_1) U^L$$

If the long-term unemployed have no impact on wage growth the coefficient attached to U^L in (2.5) would be zero, i.e. β_2 would be equal to β_1, but of the opposite sign.

Blanchard and Summers (1988) also doubt that the argument about loss of human capital is of decisive importance to explain the observed high and lasting unemployment. Some of the arguments regarding loss of

qualifications suggest that labour force participation should decline rather than that unemployment should increase as a result of adverse shocks. They also claim that the large increase in the labour participation rates by the female population in the Western countries since the second world war indicates that the importance of experience and skill should not be exaggerated. The rise in the female participation rates was however caused by a strong growth in jobs in private and public services where claims for experience and skill were not of great importance.

The third mechanism which is put forward to explain hysteresis and the percistence of high unemployment is the distinction between insider and outsider workers developed in a series of contributions by Lindbeck and Snower (see e.g. Lindbeck and Snower (1985) and (1988)). In the extreme case wages are assumed to be fixed by bargaining between employed workers, the insiders, and firms, with outsiders playing no role in the bargaining process. Insiders are concerned with maintaining their jobs and do not care about the unemployed.

These aspects are also analysed by Blanchard and Summers (1987 and 1988) in a simplified model with identical firms and workers where the group of insiders is sufficiently strong to set wages to make expected employment equal to the size of membership. It is further assumed that the wage rates are the same in all firms and that employment is equal to membership plus a disturbance equal to the effect of an unanticipated shock in the economy

$$(2.6) \quad N = M + (G-EG)$$

where M denotes membership and (G-EG) the unanticipated shock.

The crucial issue in this model is how membership is determined. If the union only cares about the currently employed from the past period (2.6) may be written as

$$(2.7) \quad N_t = N_{t-1} + (G_t - EG_t)$$

The implication of this assumption is that employment follows a random walk and is only influenced by unexpected movements in aggregate demand. For a given labour force equilibrium unemployment is equal to last period's value of actual unemployment in the standard terminology.

In the case of an adverse shock which reduces employment, some

workers loose their insider status and the new smaller group of insiders sets the wage rate so as to maintain this new lower level of employment. There is then no connection between the level of unemployment and the change in wage rates in this approach, and the equilibrium rate of unemployment moves according to the actual rate.

Although Blanchard and Summers regard the insider-outsider approach as the most promising explanation of hysteresis and hence of the high and percisting unemployment, some critical remarks have to be made. Because of competing unions and several unorganized employees it may be doubtful if a single trade union has the power to fix wages to make expected employment equal to the size of membership. Even more important is the doubt about the assumption that the trade union only cares about the currently employed while there obviously are members which are unemployed. As also pointed out by Blanchard and Summers (1987) higher unemployment means worse re-employment prospects if laid off, and thus should lead the insiders to accept a lower wage if unemployment gets larger. This may not only influence the level of wages but also the change in wage rates as a result of higher unemployment. Real wage rigidity as implied by a convex Phillips curve may however limit the downward wage adjustments, and this may make it difficult to distinguish empirically between the hysteresis approach and the Phillips curve approach at high levels of unemployment.

When unemployment increases the possibility for firms to hire workers among outsiders also increases. The bargaining position of the firms is strengthened while the bargaining position of the trade union is weakened. Although hiring costs may prevent the firms from replacing a large part of the labour force because of the presence of specific human capital, a large wage differential between the employed and the unemployed may induce hiring of unemployed. Although the hysteresis approach may be relevant, it seems dramatic to exclude that market conditions also may be of some importance.

2.3. The equilibirum rate of unemployment and NIIRU in a small open economy

In a closed economy with no change in tax wedges or other shocks affecting inflation it may be relevant to use the equilibrium rate and NIIRU synonymously. However, as pointed out by Coe (1985) this may not be the case in a small open economy where wage and price inflation to a large degree may be affected by world market prices and exchange rates.

The approach usually adopted for computing the NIIRU is based on the augmented Phillips curve, a mark-up price equation and adaptive expectations. The Phillips curve may be of the form

$$(2.8) \quad w = a_0 + a_1 p^* + a_2 p_I - a_3 U + a_4 (z-s) - a_5 t$$

and the price equation may look like

$$(2.9) \quad p = b_1 (w+s-z) + b_2 p_I$$

where
- w - the relative growth in the wage rate from previous period
- p^* - expected growth in consumption prices
- p - actual growth in consumption prices
- p_I - growth in international prices (exchange rates assumed constant
- U - the rate of unemployment
- z - growth in productivity
- s - growth in 1 + the pay-roll tax rate
- t - growth in 1 - the average income tax rate

NIIRU is defined as the rate of unemployment which gives $p^* = p = p_{t-1}$. Inserting for $p^* = p$ and (2.9) in (2.8) gives

$$(2.10) \quad \bar{U} = \frac{1}{a_3} [a_0 + (a_1 b_1 - 1)w + (a_1 b_2 + a_2) p_I + (a_1 b_1 - a_4)(s-z) - a_5 t]$$

In a closed economy $a_1 = b_1 = 1$ and $a_2 = b_2 = 0$. If $a_4 = 1$ and $a_5 = 0$ or there is no change in productivity or taxes the NIIRU may be written as

$$(2.11) \quad \bar{U} = a_0 / a_3$$

which is equal to the equilibrium rate of unemployment when g(U) in (2.3) is assumed to be linear. However a change in income taxes may affect the NIIRU in a closed economy if $a_5>0$. (A change in pay-roll taxes may also change the NIIRU in a more general model where pay-roll taxes are not included in the same way as productivity.)

In an open economy both a_1 and b_1 are less than 1 and a_2 and b_2 are positive, which means that in the general case NIIRU depends both on the change in international inflation and the change in productivity. A NIIRU calculated in this way, indicate what the level of unemployment should be to secure stable inflation and not the equilibrium rate of unemployment regarding wage inflation.

Based on estimates of the coefficients in the wage and price equation a common result in the literature (see e.g. Coe (1985) pp. 112-113) is a NIIRU which calculated by (2.10) moves according to the actual rate of unemployment. A stronger growth in prices on imported commodities and a smaller growth in productivity ($a_1 b_1 - a_4 > 0$) are held as the main explanations for the rise in NIIRU for most Western countries during the seventies and the first part of the eighties. This has then wrongly been taken as an indication of hysteresis.

In an open economy where wages change according to the Scandinavian theory of inflation as presented by Aukrust (1977) (either as a result of the negotiations or by exchange rate policy), $w = p_I + z - s$. If there is homogeneity in the price and wage equations ($a_1 + a_2 = 1$, $b_1 + b_2 = 1$), $a_4 = 1$ and $a_5 = 0$ (or there is no change in productivity or taxes), NIIRU may be calculated by (2.11) even in an open economy.

3. MISMATCH AND STRUCTURAL PROBLEMS IN THE NORWEGIAN LABOUR MARKET

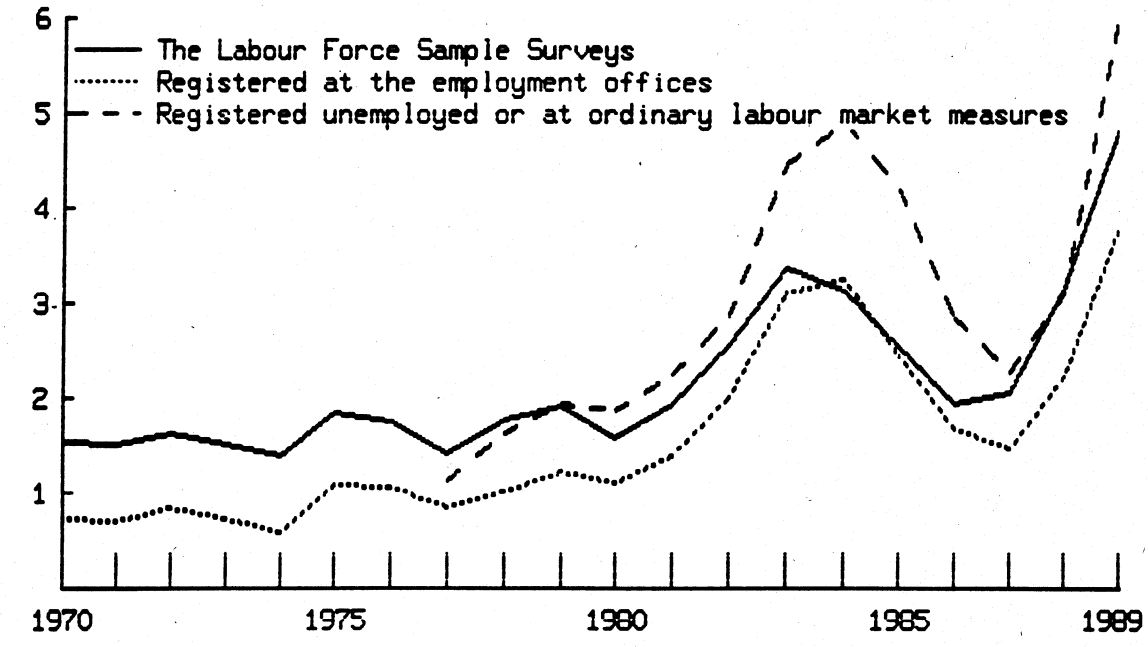
The labour market may be divided into submarkets according to job--characteristica such as industry, kind of work, claims of qualifications and the firms' localisation, or characteristica of the workers, as place of living, age, gender, education and skills. If there is excess supply in some submarkets at the same time as there is excess demand in others, this is denoted structural problems or mismatch in the labour market. Both a change in the composition of demand and supply for labour may then cause an increase in structural problems. Structural problems may also increase as a result of increasing frictions in the labour market caused by a greater diversification in submarkets, greater barriers between the submarkets, and institutional constraints which may prevent mobility.

A common way to illustrate mismatch in the labour market is to analyse the connection between the rate of unemployment U and the rate of vacant jobs V. On Norwegian data such studies have been carried out by Cappelen (1983), Falk (1988 and 1989) and in NOU 1988:24. Most of the data used in these analysises are based on the registrations of persons unemployed and vacant jobs at the labour market offices. A problem with these data is that the propensity to register may change over time and may violate the data if no correction is possible.

3.1. Unemployment

Figure 3.1 shows the rate of unemployment both according to the Labour Force Sample Surveys and the registrations at the employment offices. The rates of unemployment are calculated as per cent of the labour force equal to the sum of employment from the National Accounts and the number of unemployed according to the Labour Force Sample Survey (LFSS). Because LFSS started in 1972 and because of some weaknesses in the first years, the number of unemployed according to LFSS is constructed out of the registered unemployment for 1970 and 1971 and adjusted in 1975.

Figure 3.1. The rate of unemployment. Per cent



Up to 1980 the two curves are rather parallel with unemployment at a low level. The employment according to LFSS was somewhat higher than the registered unemployment in those years because some of the non-employed persons seeking work did not register at the employment offices. Due to a reduction in demand for labour the rate of unemployment rose considerably from 1981 to 1983, and at its peak in 1983 the number of unemployed according to LFSS reached 3.4 per cent of the labour force. The registered unemployment increased more than LFSS probably as a result of a larger propensity to register in order to join the government's job schemes.

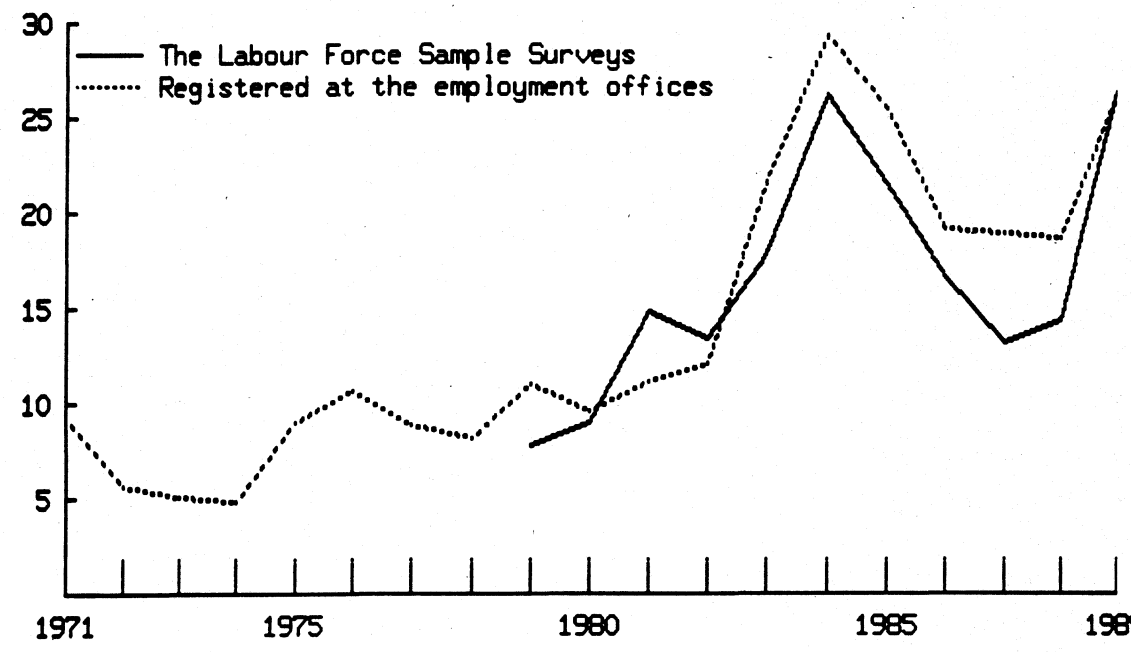
When the strong demand for labour in the period 1985 to 1987 caused the rate of unemployment to decrease again, registered unemployment decreased more than the number of unemployed according to LFSS, but the distance between the two curves in 1986 and 1987 was smaller than in the seventies indicating a shift in the propensity to register. The registered rate of unemployment also seems to lag somewhat behind the rate according to LFSS.

A bottom level of the rate of workseekers at 2.0 per cent in 1986 compared to 1.4 per cent in 1974 indicates more mismatch in the labour market in the eighties than in the seventies.

Due to lower demand for labour in 1988 and 1989 the rate of unemployment grew considerably. The number of workseekers increased faster than the number of persons registered unemployed and reached 4.9 per cent in 1989. Although the propensity to register may have increased also in the last years, the distance between the number of registered unemployed and the number of workseekers has increased again probably because some of the participants in labour market measures in 1988 and 1989 were calculated as non employed persons seeking jobs according to LFSS. While direct government employment was more common in 1983 and 1984 a larger part of the labour market measures in 1988 and 1989 consisted of increased vocational training and higher education. When the ordinary labour market measures (excluding retraining of disabled persons) are added to the registered unemployed as shown in figure 3.1, 6.1 per cent of the labour force was unemployed in 1989.

During the seventies when the number of unemployed was quite low the share of persons unemployed more than 26 weeks was at a low level. When unemployment increased during the eighties the share of long term unemployed also increased. While the first period of an increase in unemployment often is dominated by an increase in inflow, the share of long term unemployed naturally lags behind the actual unemployment. The share of persons unemployed more than 26 weeks both according to LFSS calculated as a yearly average and according to the registered unemployment calculated in January the next year are shown in figure 3.2.

Figure 3.2. Persons unemployed more than 26 weeks. Per cent of total unemployment



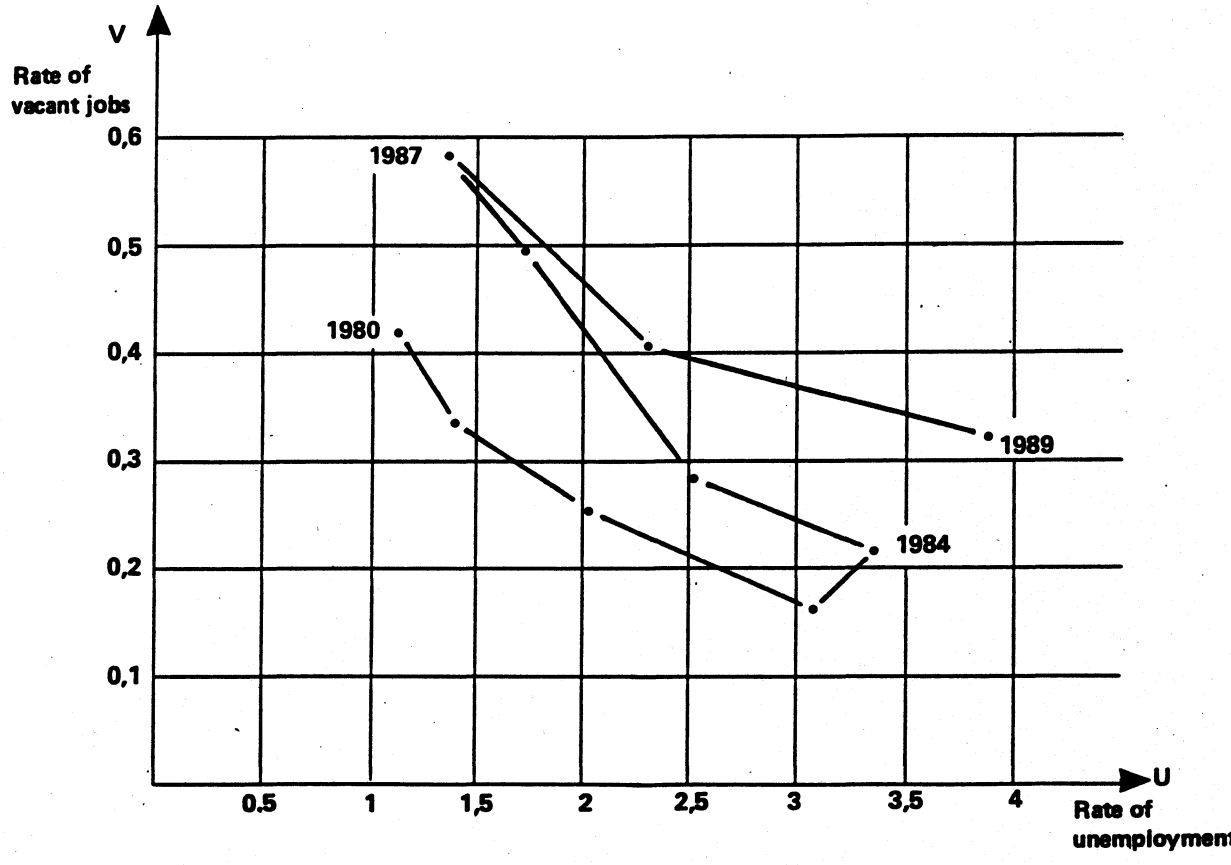
From the figure it is evident that the share of long term unemployed increased substantially in 1983 and 1984. When unemployment fell again from 1985 to 1987 the share of long term unemployed also fell, but did not reach the level it had before unemployment increased. This is an indication of growth in structural problems in the labour market. A part of the increase in the share of registered long term unemployed may however be due to the lengthening of the maximal period where unemployed are allowed to achieve unemployment benefits from 40 to 80 weeks in July 1984. In 1989 where the unemployment was rising, the share of long term unemployed also increased without bypassing the level from 1984. A relatively high number of long term unemployed joining the labour market measures may be the main reason for this.

3.2. Mismatch between vacant jobs and unemployment

Figure 3.3 shows the connection between the rate of unemployment and the rate of vacancies registered at the employment offices. An outward shift in this curve is an indication of more structural problems and mismatch. However, in an analysis based on registrations at the employment offices one has to keep in mind the possible higher propensity to register both regarding unemployment and vacant jobs.

The higher propensity to register among the unemployed during the eighties was pointed out in section 3.1. By comparing the supply of vacant jobs at the employment offices by the number of advertisements in the newspapers Falk (1988 and 1989) also concludes that the propensity to register vacant jobs increased from 1985 to 1986. New routines in registration of vacant jobs at the employment offices including registration of advertised jobs in the newspapers has led to a more complete register than before. The growth in the number of registered vacancies therefore has to be interpreted with care.

Figure 3.3. The connection between the rate of unemployment and the rate of vacancies registered at the employment offices



The figure shows a nice falling curve between the rate of unemployment and the rate of vacancies from 1980 to 1983. This result is in accordance with the conclusion drawn by Cappelen (1983) that there was no sign of an increase in the structural mismatch in the Norwegian labour market from 1970 to 1983. From 1983 to 1986 the curve indicates a shift in the structural problems, and a new shift seems to occur from 1988 to 1989. The increase in mismatch may however be somewhat exaggerated as a consequense of the higher propensity to register. This is confirmed by a higher rate of unemployment measured by LFSS in 1986/87 than in 1973/74 although the growth in employment and the pressure on the labour market was higher in the latter period than in the former. A higher share of long term unemployed in 1986/87 than in the seventies as shown by figure 3.2 is also an indication of increase in the structural problems.

It may be surprising that the structural problems did not increase between 1981 and 1983 when the rate of unemployment grew considerably, but instead increased in the period 1984 to 1986 with strong growth in employment and lower unemployment. However, because the strong growth in employment in that period, as shown by table 3.1, was concentrated to private services while the strong decline in the earlier period, and also from 1987 to 1989, was concentrated to manufacturing industries, this may be the main reason behind the growth in structural problems during the eighties.

Table 3.1. Change in employment in different industries during the eighties.[1] 1000 persons

Industry	1981-1983	1983-1985	1985-1987	1987-1989
Agriculture, forestry and fishing	-9.3	-3.7	-5.7	-6.2
Manufacturing, mining and quarrying	-33.6	-1.1	1.3	-41.0
Oil activities and ocean transport	-1.2	-2.0	-11.0	11.1
Building and construction and electricity	3.0	5.1	23.7	-18.2
Domestic transport and communication	-0.3	3.8	10.6	-6.6
Financial services	4.0	6.2	8.1	-2.9
Business and rental services	9.2	17.7	10.9	-3.5
Wholesale and retail trade	-4.0	11.4	16.2	-13.0
Other private services	7.1	9.7	25.0	-9.9
All private industries	-25.2	47.1	79.0	-90.3
Public services	21.3	18.1	25.8	18.1
Total employment	-3.9	65.2	104.9	-72.2

[1] According to the National Accounts.

3.3. The composition of unemployment

To analyse the reasons behind the structural problems in the Norwegian labour market further, it has been common to look at the composition of the unemployed by sex, age, education, region and occupation and correspondingly for vacant jobs regarding region and occupation. One procedure as demonstrated by Falk (1988 and 1989) is to analyse the dispersion of unemployment by different characterstica by calculating coefficients of variations (the standard deviation divided by the mean). The development in such coefficients from 1972 to 1989 by county, sex, age and occupation is shown in table 3.2. The coefficients by sex and age are based on LFSS while the coefficients by county and occupation are based on the registrations at the employment offices. While the coefficients by county, sex and age are based on rates of unemployment, the coefficients by occupations are based on numbers of unemployed because of no clear correspondance between the oc-

cupation classification for the unemployment figures and the industry classification for the employment series in the National Accounts.

Table 3.2. Coefficients of variation for unemployment by county, sex, age and occupation[3)]

Year	County[1)]	Sex[2)]	Age[2)]	Occupation[1)]
1972	0.50	0.20	0.92	0.69
1973	0.57	0.41	0.98	0.61
1974	0.67	0.39	1.08	0.55
1975	0.52	0.21	0.96	0.81
1976	0.51	0.22	0.89	0.63
1977	0.49	0.38	0.96	0.62
1978	0.49	0.26	0.89	0.65
1979	0.44	0.20	0.89	0.57
1980	0.52	0.28	1.01	0.55
1981	0.42	0.29	0.82	0.60
1982	0.35	0.13	0.86	0.70
1983	0.28	0.09	0.72	0.76
1984	0.29	0.02	0.74	0.66
1985	0.33	0.17	0.71	0.59
1986	0.39	0.25	0.82	0.56
1987	0.42	0.19	0.75	0.57
1988	0.39	0.06	0.81	0.64
1989	0.23	0.04	0.68	0.62

1) Unemployed persons registered at the employments offices.
2) Non-employed persons seeking work according to LFSS.
3) The coefficients of variation are based on rates of unemployment for county, sex and age and numbers of unemployed for occupation and are calculated by dividing the standard deviation by the mean.

Compared with figure 3.1 the table shows a negative correlation between the coefficients of variation and the rate of unemployment both regarding sex and county. The coefficients of variations by these characteristica were relatively high during the seventies when unemployment was low, declined substantially in 1982 to 1984 when the rate of unemployment was relatively high, increased again in 1985 to 1987 when the labour market was tight, and finally decreased to a low level in 1989.

Regarding sex, the reason is that men to a larger degree work in sectors which are influenced by business cycles than women, i.e. manufacturing and building and construction. In economic slowdowns which have caused rather large reductions in employment in manufacturing men are more severe affected than women. In economic upswings however the growth in employment seems particularly to have been strong in private and public services where a large share of the employees are women. The service sectors are also to a large degree concentrated in central areas with traditionally low unemployment. In a tight labour market the demand pressure in the central areas seems to have been very high increasing the coefficients of variation by county. The slowdowns reducing employment in manufacturing industries seem to have affected both central and rural areas. Norway thus seem to have experienced the rather paradoxal situation that mismatch problems by sex and region seem to have decreased when unemployment increased and vice versa.

The coefficients of variation by age are calculated based on the rates of unemployment for the groups, 16-19, 20-24, 25-49 and 50-74 years from LFSS. Statistical uncertainty as a result of a rather small number of people in the different groups of unemployed may cause rather large fluctuations in the series. A special problem occurs for the youngest group, 16-19 years, where most of the population is full time at school and thereby outside the labour force leaving the rate of unemployment very high and to a large degree dependent on the share taking full-time education. Although the coefficients of variation by age also seem to move countercyclically, this is not as clear as by sex and region. Fluctuations in the rate of unemployment thus seem to hit all groups of age in a similar way.

The coefficients of variation by occupation are calculated based on the number of unemployed registered at the employment offices by seven groups of occupation, work in Primary sectors, Mining and manufacturing, Building and construction, Transport and communication, Administration, offices and sale, Services and Technical, physical and humanistic work. An objection to this division is that it may be arbitrary and the coefficient of variation may of course to a large degree depend on the composition of the different groups.

Contrary to region, sex and age the coefficient of variation by occupation shows a procyclical pattern. According to the classification the number of unemployed has been highest in the group mining and manufacturing, and it is also this group which has showed the greatest increase

in unemployment during slowdowns reflecting the change in unemployment showed in table 3.1. However, the coefficients of variation were not higher at the end of the eighties where unemployment was high than in the seventies were unemployment was low, indicating that the importance of occupational mismatch should should not be exaggerated.

To conclude this section it seems that mismatch problems in the Norwegian labour market has worsened in the period 1984-1989 while there seems to be no significant signs of change from 1970 to 1983. The main reason behind the worsening from 1984 seems to be the large fluctuations in the Norwegian economy implicating dramatic shifts in the composition of demand for employment by industry and occupation. It is too early to say if the structural problems declines if the changes in employment by industry smooth out, or if a larger number of long term unemployed has worsened the mismatch problems. Because of higher propensity to register both regarding unemployment and vacant jobs, the increase in structural problems indicated by the series from the employment offices may be exaggregated. The rate of unemployment from LFSS is thus a better indicator for the pressure on the labour market than the registered unemployment. A possible imperfect correlation between unemployment and vacant jobs implies that the rate of vacancies has to be taken into consideration in an analysis of the pressure on the labour market. The change in the degree of registration may also cause problems in using this variable.

4. WAGE EQUATIONS FOR NORWEGIAN MANUFACTURING INDUSTRIES

To investigate the existence of hysteresis it has been common (see e.g. Coe (1990)) to estimate wage equations and test alternative hypotheses. The point of departure has been to start with a rather general specification which nests alternative models of the wage formation process. However, wages may be influenced by a lot of factors and some apriori restrictions have to be made. For a small, open economy like Norway it seems natural to start with the Scandinavian theory of inflation and impose some restrictions using earlier experiences regarding empirical analyses of wage formation.

4.1. Phillips curve versus hysteresis

As presented in NOU 1988:24 (page 142) a general wage equation for manufacturing industries may look like:

$$(4.1)\quad \Delta w_t = c_0 + c_1/U^2_{t-1} + c_2(L)\Delta p_t + c_3(L)\Delta p_{It} + c_4(L)\Delta z_t - \Delta s_t + c_5\Delta h_t + c_6 DUM79 + c_7\Delta n_t + c_8(w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1})$$

where lower case letters means that the variables are in natural logaritms, and Δ indicates differences of the first order.

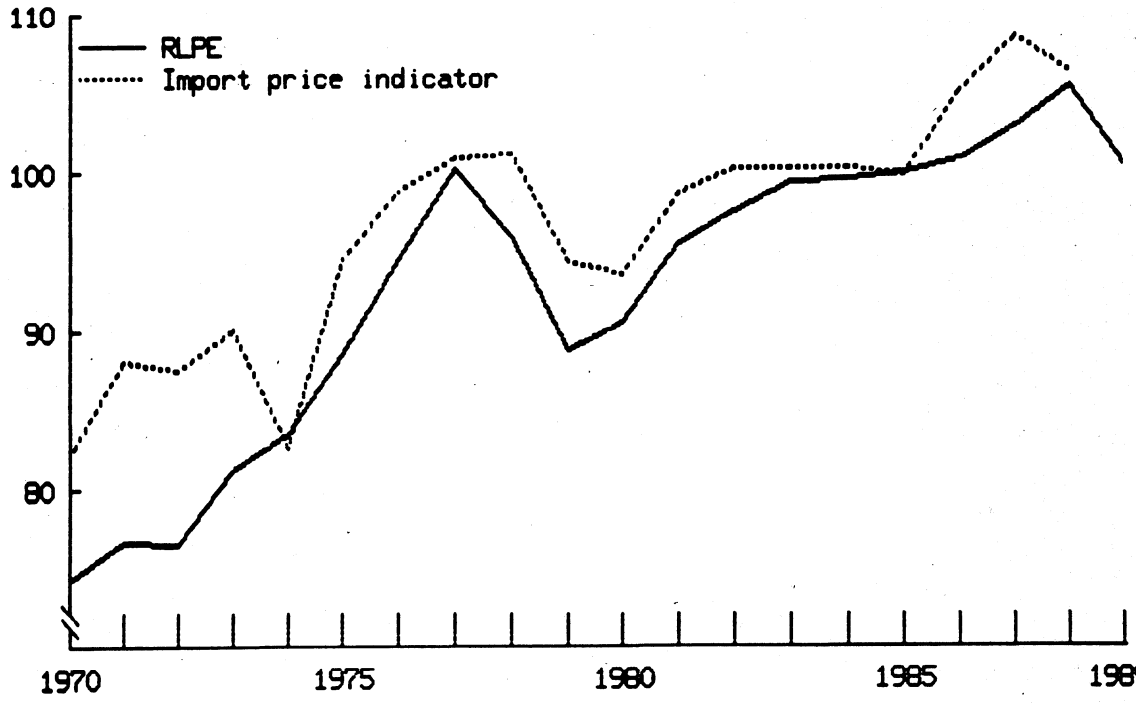
- w - nominal hourly wage rates according to the national accounts,
- U - the rate of unemployment in the whole economy according to the labour force sample surveys,
- p - the official consumer price index,
- p_I - price index on competing imported manufactured products according to the national accounts,
- z - value added per man hour according to the national accounts,
- s - logaritm of 1 + the pay roll tax rate,
- h - normal annual working hours according to the national accounts,
- DUM79 - dummy-variable for the wage and income freeze in 1978 and 1979,
- n - the number of wage earners employed in manufacturing industries according to the national accounts.

Earlier estimations indicate that the coefficient in front of Δs is not significantly different from -1 for manufacturing industries while

changes in income taxes only seem to be of minor importance and are therefore omitted. It is convenient to represent the effect from the rate of unemployment as $1/U^2_{t-1}$. $c_3(L)$ and $c_4(L)$ are distributed lags of three years while $c_2(L)$ is a distributed lag of two years. As a consequence of an assumption of price homogeneity the restriction $c_2(L) + c_3(L) = 1$ is tested in the analysis.

The equation states that growth in nominal wage rates in manufacturing industries depends on specific manufacturing industry variables such as changes in prices on competing products, productivity, employment and normal working hours. In addition macroeconomic variables such as the rate of unemployment, consumer prices and regulations by the central government may affect wage formation in the manufaturing industries. The last term in (4.1) is an error-correction term assuming that wage rates in the long run develop according to the Scandinavian theory of inflation. In this theory wage rates have to grow according to prices on competing foreign products, productivity and pay-roll taxes to maintain the competitiveness. If this long term connection holds, wages, foreign prices, productivity and pay-roll taxes are said to be cointegrated, see Engle and Granger (1987). As may be seen from figure 4.1 Norwegian manufacturing industries have lost competitiveness during the last two decades indicating that large doubt may be raised about the cointegrating property of the chosen variables. DickeyFuller tests reported in appendix I also indicate that wage costs relative to foreign prices and productivity (denoted import price indicator in figure 4.1) is a non-stationary variable over the period 1965 to 1987.

Figure 4.1. Relative wage costs per unit produced and import price indicator for competitiveness in Norwegian manufacturing industries



As pointed out by Coe (1990) alternative models of the wage formation process such as the equilibrium rate/Phillips curve model, the insider-outsider/hysteresis model and the real-wage bargaining model are nested in the general specification (4.1). The fundamental differences between the alternative models concern the nature of the long-run equilibrium and the forces which move the labour market to that equilibrium. The coefficients which discriminate between the alternative models are those for the aggregate unemployment rate (c_1), the change in manufacturing employment (c_7) and the error-correction term (c_8). The error-correction term determines if the equation is in level ($c_8<0$) or growth rate form ($c_8=0$).

i) The equilibrium rate/Phillips curve model is implied if the estimated equation is in growth-rate form ($c_8=0$) and the level of unemployment exerts a significant negative effect ($c_1>0$). In the long run unemployment equals the equilibrium rate and real wage growth is, with some modifications, equal to growth in productivity. If the change in indu-

stry employment is significant ($c_7>0$) this will imply loops around the Phillips curve.

ii) The insider-outsider/hysteresis model is implied if the estimated equation is in growth-rate form ($c_8=0$) and changes in industry employment have a significant effect on wage growth ($c_7>0$) but the level of unemployment does not ($c_1=0$). Like in the Phillips curve model, real wages grow according to productivity in the long run, but there is no equilibrium rate of unemployment in this model.

iii) The real-wage bargaining model is implied if the estimated equation is in level form ($c_8<0$) indicating a long-run equilibrium relationship between nominal wages, pay-roll taxes, foreign prices and productivity. This model has an equilibrium with respect to the level of real wages, but not with respect to unemployment. If unemployment has a significant impact ($c_1>0$) there is a long-run relationship between the level of wages and the level of unemployment. This implies a long-run relationship between the growth of wages and the change in unemployment similar to the insider/outsider hysteresis model.

The main difference between the three models is that while a negative shock in demand for labour only will have a temporary effect on wage growth in the insider-outsider/hysteresis and the real-wage bargaining models, there is a permanent effect in the Phillips curve model until equilibrium is restored in the labour market with unemployment being equal to the equilibrium rate.

Table 4.1. Wage equations for manufacturing industries

	Estimated coefficients						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.100 (0.58)	0.002 (0.10)	-0.0095 (0.88)	-0.01*)	-1.29 (1.46)	-1.33 (1.59)	-2.46 (3.63)
$1/U^2_{t-1}$	0.086 (1.95)	0.070 (0.56)	0.070 (2.73)	0.085 (8.31)	0.125 (2.62)	0.126 (2.75)	0.143 (3.85)
Δp_{t-1}	0.21 (0.85)	0.16 (0.75)	0.23 (1.28)	-	0.28 (1.19)	0.25 (1.17)	0.50 (3.24)
Δp_I	0.10 (0.89)	0.15 (2.10)	0.16 (2.56)	0.18 (3.08)	0.09 (0.92)	0.10 (1.16)	0.12 (1.25)
Δp_{It-1}	0.40 (2.83)	0.42 (3.31)	0.44 (3.75)	0.54 (8.04)	0.24 (1.48)	0.24 (1.53)	-
Δp_{It-2}	0.16 (1.38)	0.17 (1.60)	0.17	0.28	0.16 (1.54)	0.17 (1.73)	-
$\Sigma\Delta p_I$	0.65	0.73	0.77	1*	0.49	0.52	0.12
Δz_t	0.40 (1.96)	0.38 (2.02)	0.40 (2.40)	0.50 (4.40)	0.20 (0.87)	0.18 (0.85)	-0.09 (0.58)
Δz_{t-1}	0.23 (0.96)	0.18 (0.95)	0.25 (1.73)	0.20 (1.74)	0.24 (1.06)	0.25 (1.14)	-
Δz_{t-2}	0.32 (0.18)	0.32 (2.57)	0.35	0.30	0.23 (1.31)	0.25 (1.65)	-
$\Sigma\Delta z_t$	0.95	0.88	1*	1*	0.66	0.68	-0.09
Δh_t	-0.54 (1.84)	-0.58 (2.19)	-0.63 (2.59)	-0.62 (2.70)	-0.67 (2.35)	-0.69 (2.58)	-0.70 (2.40)
DUM79	-0.076 (3.94)	-0.074 (4.18)	-0.073 (4.39)	-0.084 (6.21)	-0.050 (2.06)	-0.049 (2.11)	-0.024 (1.27)
Δn_t	0.133 (0.48)	-	-	-	0.100 (0.38)	-	0.24 (0.97)
$w_{t-1}+s_{t-1}-p_{It-1}-z_{t-1}$	0.038 (0.57)	-	-	-	-0.172 (1.19)	-0.181 (1.32)	-0.372 (3.32)
$s_{t-1}-t_{t-1}+p_{t-1}-p_{It-1}$	-	-	-	-	0.142 (1.60)	0.145 (1.71)	0.256 (3.75)
Statistics							
DW	2.00	1.83	1.85	2.06	2.18	2.19	1.65
SER	0.0134	0.0126	0.0119	0.0121	0.0125	0.0120	0.0137
SSR	0.0018	0.0019	0.0020	0.0024	0.0014	0.0014	0.0024

1) T-statistics in brackets.
*) Fixed apriori.
Estimation method: OLS, Estimation period: 1965-1987

The results from the estimation of the general specification (4.1) are presented in table 4.1, column (1). Both the coefficients regarding the change in employment and the error correction term are insignificant, and the error-correction coefficient is also of the wrong sign. By dropping both these variables ending up with the traditional Phillips curve as shown by column (2) the performance measured by the standard error of regression is still about the same level as in the general model. This contradicts the results found by Coe (1990) which indicates a significant error correction term in wage formation of the Norwegian manufacturing industries. The main reasons behind this discrepancy seem to be use of different data and fewer lags on prices and productivity in Coe's study.

Instead of prices on competing foreign products Coe (1990) uses an implicit output deflator. As the Norwegian manufacturing industries to a large degree seem to have shifted increased costs to higher prices the output price deflator has increased more than the deflator on competing products. Thus a simultaneity problem may affect Coe's results, and the derived loss in competitiveness is underestimated.

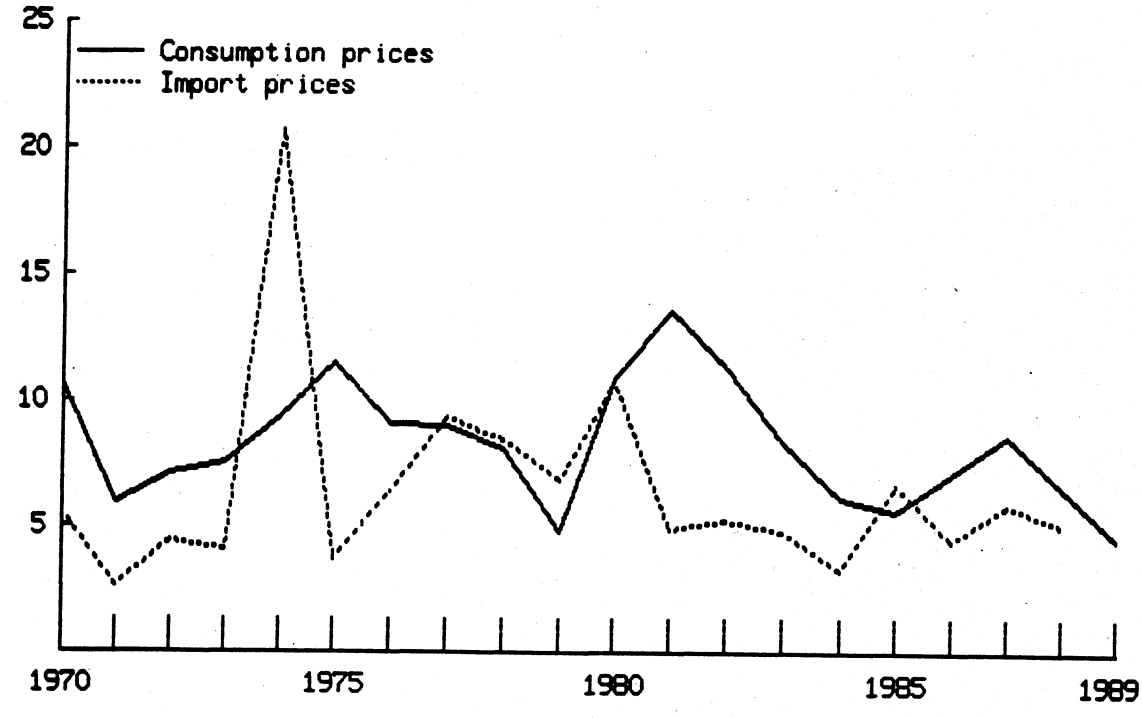
Growth in prices on foreign products and productivity in the manufacturing industries show great fluctuations, and it is the long term movements which are of importance for growth in wage rates. By including too few lags in the exogenous variables some of the dynamics is caught up in the error correction term and contributes wrongly to the significance of this term in Coe's study.

The general specification (4.1) implies that wage rates grow according to foreign prices, productivity and pay-roll taxes. Even in the Phillips-curve specification this seems like a reasonable theoretical restriction when the actual rate of unemployment is equal to the equilibrium rate. In relation (2) the sum of coefficients in front of prices (consumer prices and import prices together) and productivity do not deviate much from 1, and these homogeneity restrictions are imposed in relation (3) without significantly weakening the tracking performance. As shown in appendix II relation (3) also passes tests for autocorrelation, misspecification, heteroskedasticity and normality in the residuals. Cusum and Chow tests indicate however some problems with parameter stability especially in 1987. This may be due to the effects on hourly wages of the shortening of normal working hours that year, influencing the other coefficients catching up short-run dynamics. The long term properties of the relation are not much influenced.

Because of a rather parallel development in consumer prices and import prices in the long run as shown by figure 4.2 the standard deviations of the estimated coefficients in column (3) are rather large because of partial multicollinearity. Consumer prices are insignificant and are excluded in column (4). This of course increases the effect of the import prices, and the t-values of the coefficients are also increased without a severe worsening of the tracking performance. The F-observator F(2,14)=1.41 indicates that (4) cannot be rejected against (3).

When consumer prices are excluded the constant term gets very small (in absolute value), reflecting the problems of estimating a stable value for this term. The constant term may be interpreted as the change in real wages in a situation with high unemployment and no change in productivity. Only two years (1983 and 1984) with somewhat higher unemployment than normal in the period of estimation explains the problems with estimating the constant term. In relation (4) the constant term is fixed to -0.01 implying a reduction of real wages of 1 per cent a year when there is high unemployment and no growth in productivity.

Figure 4.2. Growth in the official consumer price index and in prices on imported manufactured goods. Per cent



4.2. Inclusion of wedge variables

As shown by figure 4.2 the increase in consumer prices has been larger than the rise in import prices during the last two decades. Theories based on perfect competition as well as trade unions and bargaining assume that taxes and consumer prices influence wage formation. Because of the co-integrating properties of the different variables Nymoen (1989) includes a wedge variable of the form

$$(4.2) \quad s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1}$$

in addition to the error correction term in his wage equation, where t denotes the logarithm of 1 - the average income tax rate. The reasons for including the wedge term is that real disposable income may be of importance for the employees. An increase in tax rates and a larger increase in domestic consumer prices than prices on competing products may then lead to a larger increase in wage rates than compatible with the Scandinavian theory of inflation. From appendix II it is also clear that the wedge variable is non-stationary and therefore may be a possible factor explaining the loss in competitiveness.

When adding the term (4.2) as an explanatory variable to the wage equation (4.1), both the error correction term and the wedge term turn out to be of correct sign, but not significant as shown by columns (5) and (6). A F-statistics F(5,9)=0.71 when testing (3) against (5) neither indicates that the Phillips curve specification is significantly weaker than the more general specification.

The long term parameters derived from column (6) are remarkably similar with the results found by Nymoen (1990). The steady state solution from column (6) is given by

$$(4.3) \quad w - z = 0.80p + 0.20p_I + \text{other terms}$$

while Nymoen's steady state solution may be written as

$$(4.4) \quad w - z = 0.79p + 0.21p_I + \text{other terms}$$

While both steady state solutions give about equal weight to the consumer prices versus import prices, Nymoen's results favour the more general re-

lation with both a wedge and an error correction term compared with a Phillips curve. Use of different data and fewer lags on prices and productivity in Nymoen's analysis are probably the main reasons why he like Coe rejects the Phillips curve.

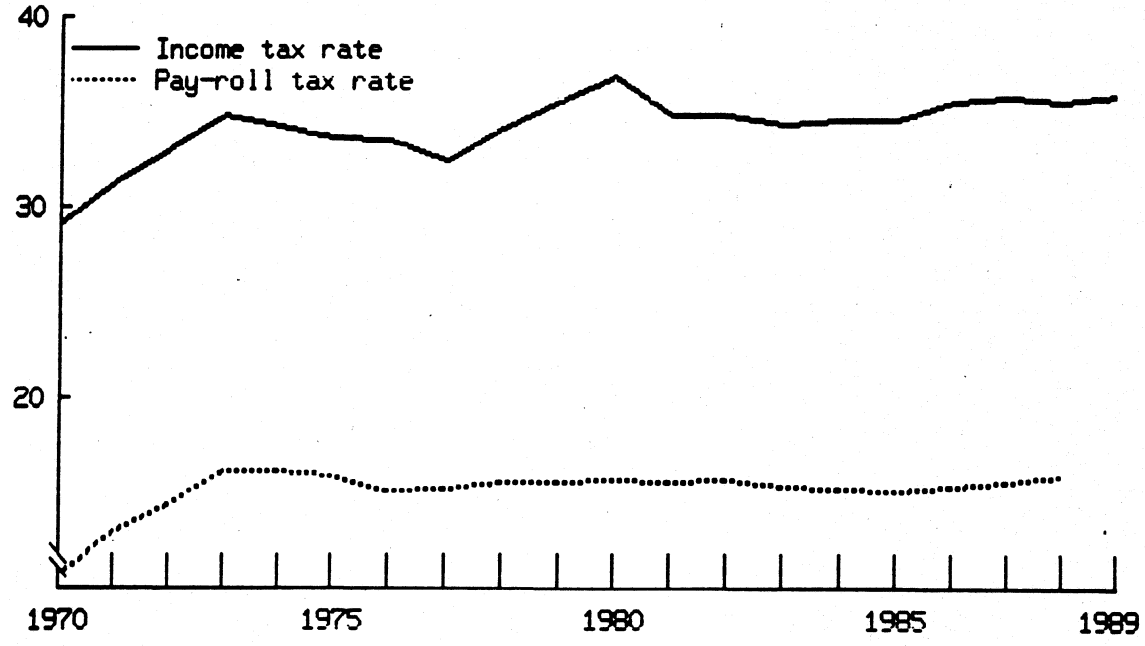
The last point is shown in column (7) where the lags on both import prices and productivity are excluded. The importance of both the error correction term and the wedge variable increases compared to (5) and (6), but $F(4,9)=1.63$ when testing (7) against (5) indicates that neither (7) is significantly weaker than the general specification.

The choice of direction therefore seems to be the main problem in moving from the general specification to a more parsimonious model. As an error-correction term catches up some part of the dynamics, this term and lags on the explanatory variables may turn out to be alternatives. When it seems difficult to discriminate empirically between the two directions theoretical background and long term properties are decisive. A problem with the steady state solutions (4.3) and (4.4) seems to be that a large weight is put on consumer prices versus import prices although manufacturing industries are heavily exposed to foreign competition. The Phillips curve specification (3) putting more weight on import prices is therefore more satisfactory according to the Scandinavian theory inflation.

As pointed out in Stølen (1987) an increase in wage rates and government regulated prices will in the long run lead to an increase in the consumer prices by more than one half the increase in wages. This means that there is a rather strong simultaniety in wages and prices for the whole economy in the long run and use of the wedge term as an independent explanatory factor in the wage equation may be doubtful.

It then seems reasonable to conclude that the pressure in the labour market has been an important factor behind the loss in competitiveness for the Norwegian manufacturing industries the last two decades. It is however difficult to reject an hypothesis that an increase in the wedge variables has been of some importance. As shown by figure 4.3 both the pay-roll tax rate and the income tax rate increased up to 1973 but have been almost constant since then. The increase in the wedge after 1973 is therefore mainly due to a stronger growth in consumer prices than prices on imported competing products.

Figure 4.3. Average pay roll tax rate for manufacturing industries and average income tax rate for a single average wage earner in manufacturing with standard tax deductions. Per cent of income



4.3. Further tests of hysteresis

To elucidate the question of hysteresis further, alternative ways of including the rate of unemployment has been suggested. Based on the argument of loss of human capital among the long-term unemployed discussed in chapter 2, it has been suggested that the change in unemployment may be a better explanatory factor for the development of real wages rather than the level of unemployment.

In relation (7) shown in table 4.2 a distributed lag of changes in the rate of unemployment is included in a traditional Phillips-curve specification with homogeneity restrictions, no effects from consumer prices and the constant term fixed to -0.01. The changes in unemployment in periods t-1 and t-2 only seem to be of minor relevance, while the change in the present period is not significant. The coefficient for the level of unemployment is about the same as in relation (4), in table 4.1, and the tracking performance is only modestly improved by including changes in unemployment.

Table 4.2. Wage equations for manufacturing industries

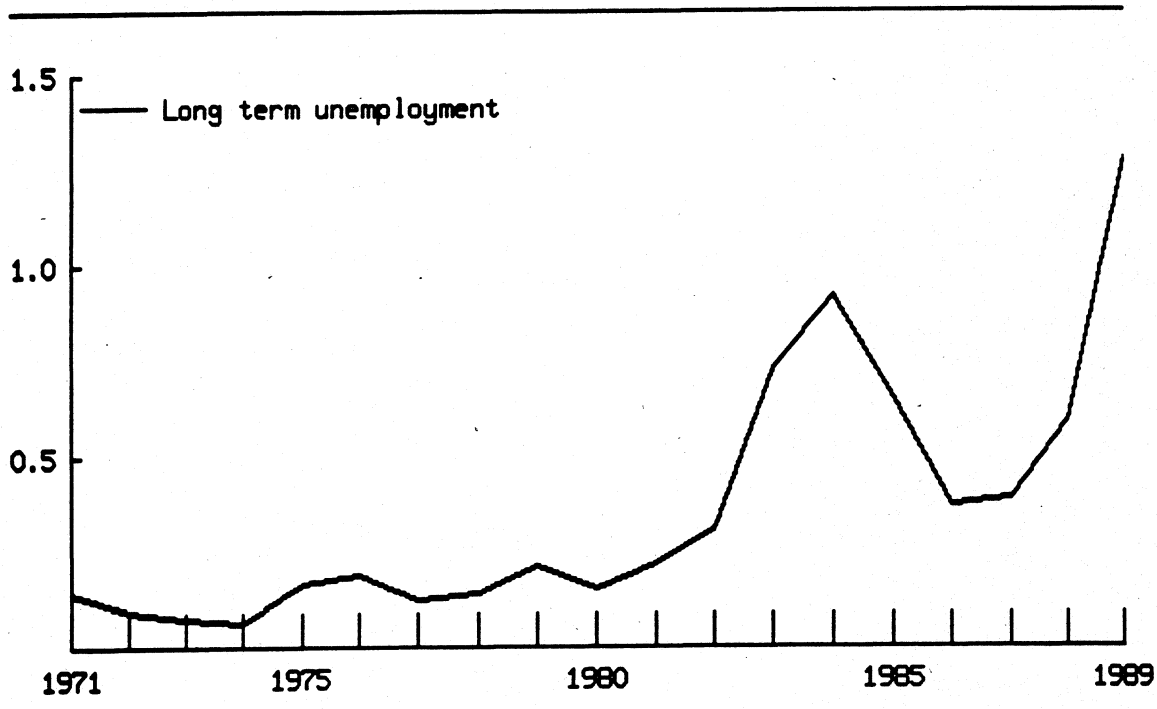
Varibles	Estimated coefficients[1)]						
	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Constant*	-0.01	-0.01	-0.01	-0.01	-0.027 (0.70)	-0.01	-0.01
$1/U^2_{t-1}$	0.085 (7.87)	0.110 (2.26)	-	0.071 (3.18)	0.136 (1.44)	0.0800 (7.31)	0.072 (3.14)
$1/U^2_{t-2}$	-	-0.022 (0.34)	-	-	-	-	-
$1/U^2_{t-3}$	-	-0.052 (0.87)	-	-	-	-	-
$1/U^2_{t-4}$	-	-0.055 (1.31)	-	-	-	-	-
$\Sigma\ 1/U^2$	-	-0.0859	-	-	-	-	-
$1/US^2_{t-1}$	-	-	0.056 (3.61)	-	-	-	-
$1/UL^2_{t-1}$	-	-	0.000 (0.56)	0.000 (0.12)	-	-	-
Δu_{t-1}	-0.010 (0.40)	-	-	-	-	-	-
Δu_{t-2}	-0.009 (0.36)	-	-	-	-	-	-
$\Sigma\Delta u$	-0.019	-	-	-	-	-	-
Δp_{It}	0.18 (2.63)	0.16 (2.31)	0.24 (3.77)	0.25 (3.57)	0.20 (3.16)	0.23 (0.06)	0.21 (1.37)
Δp_{It-1}	0.52 (6.75)	0.56 (6.33)	0.54 (7.94)	0.55 (7.38)	0.46 (3.72)	0.54 (0.07)	0.57 (5.75)
Δp_{It-2}	0.30	0.28	0.22	0.20	0.34	0.23	0.22
$\Sigma\Delta p_I$*	1	1	1	1	1	1	1
Δz_t	0.49 (3.57)	0.53 (3.80)	0.52 (4.11)	0.49 (3.65)	0.36 (1.61)	0.54 (4.71)	0.52 (2.73)
Δz_{t-1}	0.25 (1.75)	0.14 (0.79)	0.28 (2.01)	0.30 (2.00)	0.30 (1.28)	0.20 (1.70)	0.31 (1.50)
Δz_{t-2}	0.26	0.33	0.20	0.21	0.34	0.26	0.17
$\Sigma\Delta z$*	1	1	1	1	1	1	1
Δh_t	-0.60 (2.43)	-0.61 (2.35)	-0.91 (3.10)	-1.00 (3.28)	-0.46 (1.06)	-0.83 (3.23)	-1.00 (2.61)
DUM79	-0.084 (5.64)	-0.082 (5.13)	-0.080 (5.95)	-0.080 (5.47)	-	-0.084 (6.28)	-0.081 (4.38)
Period of estimation	1965- 1987	1966- 1987	1972- 1987	1972- 1987	1965- 1977	1970- 1987	1975- 1987
Statistics							
DW	2.14	1.82	2.28	2.10	1.98	2.46	2.12
SER	0.0128	0.0129	0.0116	0.0125	0.0116	0.0118	0.0138
SSR	0.0023	0.0020	0.0011	0.0013	0.0008	0.0015	0.0012

* Fixed apriori.

Another way of testing the hysteresis effect as suggested by Coe (1988) is to include a distributed lag on past values of U_t. This estimation is shown in relation (8) in table 4.2. However, the coefficients for U_{t-2} to U_{t-4} are not significant, and regarding U_{t-3} also of the wrong sign. The coefficient for U_{t-1} is larger than for the simple Phillips curve in relation (4), and the sum over all periods is about the same. No signs of hysteresis may be found in this estimation.

Coe (1988) also suggests that the change in the equilibrium rate of unemployment may be approximated by the rate of long-term unemployment. Because of a rather low unemployment in Norway during the sixties and the seventies it has proved difficult to establish satisfactory time series for this variable. The variable used for estimation showed in figure 4.4 is calculated on the basis of the rate of unemployment according to the Labour Force Sample Surveys combined with the share of registered unemployed more than 26 weeks.

Figure 4.4. The rate of long term unemployed. Per cent of the labour force



The estimations with this variable presented in relations (9) and (10) in table 4.2 show that the rate of long-term unemployed have no signi-

ficant effect on wage formation supporting that some hysteresis effects may be present. However, as may be seen from the figure, except from the years 1983 to 1985, the rate of long-term unemployed was quite low during the whole period of estimation. It is therefore not surprising that there is only a weak correlation between long term unemployment and wage growth. The trend in the rate of long-term unemployed is however increasing, indicating increasing structural problems in the Norwegian labour market during the period of estimation.

4.4. Changes in the equilibrium rate of unemployment

As concluded in chapter 3 the structural problems in the Norwegian labour market seem to have increased since 1983. It is therefore of interest to investigate if the equilibrium rate of unemployment implied by the wage equations also have increased during the eighties. This may be done by estimating Phillips curves for different periods and comparing the computed natural rates. With the chosen specification for the unemployment term in (4.1) the equilibrium rate of unemployment may be calculated by $U^* = \sqrt{c_1/-c_0}$.

The coefficients from equations (3) and (4) in table 4.1 give an equilibrium rate for wage formation in manufacturing industries of about 2.7 to 2.9 per cent. This is about the same as reported in NOU 1988:24.

The relatively low and stable rate of unemployment in the sixties and seventies has made it difficult to obtain a precise estimate of the equilibrium rate of unemployment ending the period of estimation before 1980. Relation (11) in table 4.2 shows the results from estimating a traditional Phillips curve specification with no effects from consumer prices and homogeneity restrictions based on the period 1965-1977 giving an equilibrium rate of unemployment of 2.2 per cent. Both the constant term and the coefficient for unemployment are however rather imprecise. Relations (12) and (13), based on the periods 1970-1987 and 1975-1987 respectively, give an equilibrium rate of 2.7-2.8 per cent, about equal to the average equilibrium rate for the whole period 1965-1987. With a lower equilibrium rate in the beginning of the period this may imply that it may have risen to about 3 per cent during the eighties reflecting the growth in structural problems discussed in chapter 3. Recursive estimations also show an increasing equilibrium rate during the eighties, and after the peak in unemployment in 1983/84 the estimates are also more precise than before.

5. CONCLUSIONS

Estimation of wage equations for Norwegian manufacturing industries indicates that a Phillips curve specification performs about as well as a more general error-correction model or an error-correction model with a wedge variable. This indicate that the low and stable rate of unemployment during the sixties and the seventies probably is the main reason behind the loss in competitiveness for the manufacturing industries in that period. The equilibrium rate of unemployment is estimated to be in the interval 2.0-2.5 per cent, which is higher than the actual rate during most of the period. The estimates are however rather imprecise. There were no signs of an increase in the structural mismatch between unemployment and vacancies in the period 1970 to 1983. Some of the loss in competitiveness may however have been caused by increases in the pay-roll taxes up to 1973 and weaknesses in price and wage formation driving a wedge between the growth in wage rates necessary to maintain competitiveness and wage rates necessary to maintain real disposable incomes.

During the eighties the rate of unemployment has increased, and has probably contributed to reduce the loss of competitiveness. However, from 1984 to 1989 the structural problems also seem to have increased implying an increase in the equilibrium rate of unemployment to about 3 per cent. The reason behind the rise in the structural mismatch seems to be the large fluctuations in the Norwegian economy implying dramatic shifts in the composition of demand for labour by industry.

The rate of long-term unemployed has also increased indicating larger mismatch problems. It may be too early to say if these problems declines if the changes in employment by industry smooth out, or if the large number of long-term unemployed has caused a more permanent shift outwards. Although a Phillips curve specification seems to explain the growth wage rates in the Norwegian manufacturing industries quite well during the seventies and the eighties, some hysteresis effects may not be excluded if the unemployment continues to stay at a rather high level. In such a situation it may also be difficult to distinguish between a rather flat Phillips curve and the hysteresis approach.

APPENDIX I. ANALYSING TIME SERIES PROPERTIES

When looking for the most relevant explanatory factors for a time series variable, it has been quite common in the economic literature the last decade to pay more attention to time series properties. An important argument pointed out by Granger and Newbold (1974) is that the conventional use of R-squared and t-values may be misleading if the variables in a regression model are non-stationary time series. This argument has, together with the practical success of the Box-Jenkins methology and a growing awareness of the need for a proper dynamic econometric modelling, materialized into a huge literature originating from the socalled LSE econometricians (see e.g. Davidson et al (1978), Harvey (1981), Hendry and Richard (1983) and Spanos (1986)). The main idea advocated by the LSE econometricians is to combine differences and levels in the same model. This means that short run dynamics and long run fluctuations are modelled simultaneously. The error-correction model is the most widely used dynamic specification emerging from this programme. In this model the change in the dependent variable is explained by the lagged deviations from an equilibrium path.

The concept of co-integration has advanced the literature of dynamic econometric modelling further the recent years (see Granger (1986), Engle and Granger (1987) and Engle and Yoo (1987)). Variables are said to be co-integrated if each of them is non-stationary (integrated of degree 1, I(1) or higher), but there exists a linear combination of them which is stationary, I(0). One very important result by Engle and Granger (1987) is that a system with non-stationary but co-integrated variables may be represented as an error-correction model.

In his works Nymoen (1989 and 1990) uses the LSE methology in analysing wage formation in Norway. In the general wage equation (4.1)

$$\Delta w_t = c_0 + c_1/U^2_{t-1} + c_2(L)\Delta p_t + c_3(L)\Delta p_{It} + c_4(L)\Delta z_t - \Delta s_t$$
$$+ c_5\Delta h_t + c_6 DUM79 + c_7\Delta n_t + c_8(w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1})$$

the error-correction term $(w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1})$ implies an assumption of wage rates developing according to the Scandinavian theory of inflation in the long run. In this theory wage rates have to grow according to prices on competing foreign products, productivity and pay-roll taxes to

maintain competitiveness. If this long term connection holds, wages, foreign prices, productivity and pay-roll taxes are cointegrated variables.

The rate of unemployment is included on the level form in (4.1). If $c_1 > 0$ and $c_8 < 0$ the steady state solution to (4.1) is given by

$$w = - c_0/c_8 + p_I + z - s - c_1/(c_8 U^2_{t-1}) - (c_6/c_8)DUM79$$

This gives a long run relationship between the level of unemployment and the level of wage rates. A change in unemployment to a new level will in this model only have a short run effect on wage inflation. If, however, $c_8 = 0$ we have a traditional Phillips curve. In this case a change in the rate of unemployment to a new level will have a lasting effect on wage inflation in this single wage equation. If the rate of unemployment moves under some natural rate this may mean a continually loss in competitiveness, even if $c_3(1)$ and $c_4(1)$ equal to one (and the other coefficients equal to 0). As pointed out by Nymoen (1990), the conditional variance of the competitiveness is unbounded in this case while it is bounded in the error-correction model.

It is however important to note that this argument does not hold in a model where a Phillips curve is combined with a falling demand curve for labour or an increasing supply curve. In such a model wage growth deviating from the Scandinavian theory of inflation as a result of the rate of unemployment differing from the natural rate, will move the rate of unemployment back to the natural rate again in the long run, also giving an equilibrium level of wage rates.

The time series properties of the rate of unemployment and the degree of competitiveness may indicate which theory is the most relevant in explaining wage formation. Nymoen (1990) discusses this in four windows according to the stationary properties (I(0) or I(1)) for the index of competitiveness and the rate of unemployment, under the assumption that both the growth in wages rates and the other growth variables in (4.1) are I(0):

i) In the case where both the index of competitiveness and the rate of unemployment are I(0), there are no I(1) terms (4.1). Both $c_1 > 0$ and $c_8 < 0$ may be possible in this model, giving the Scandinavian model of inflation with a short term unemployment effect.

ii) In the case where the rate of unemployment is I(0) while the index of competitiveness is I(1) the rate of unemployment match the I(0) property of wage inflation. If $c_1 > 0$, $c_3(L) = c_4(L) = 1$ and other coefficients equal to 0, there is a Phillips curve indicating that deviations in the rate of unemployment from its natural rate may cause changes in competitiveness.

iii) In the case where the rate of unemployment is I(1) while the index of competitiveness is I(0) it seems reasonable that unemployment is not a relevant variable explaining wage growth, and $c_1 = 0$. This gives the Scandinavian model of inflation with no unemployment effect, where changes in the other variables may give short term fluctuations within the wage corridor.

iv) In the case where both the rate of unemployment and the index of competitiveness are I(1), neither of these factors may explain wage growth unless they are cointegrated. Even if $c_3(1) = c_4(1) = 1$, changes in some of the other variables may cause deviations from the Scandinavian model of inflation, and there is no correction for this. However, when the rate of unemployment and the index of competitiveness are cointegrated, there is a long term relationship between the levels of the two variables.

Dickey and Fuller (see Fuller (1976) and Dickey and Fuller (1979 and 1981) have developed rather simple tests based on ordinary "t"- and "F"-statistics to analyse the time series properties of a variable. However, these tests may be somewhat arbitrary in the question of a deterministic trend, a constant term and how many lags in the change of the actual variable which ought to be included. Seasonally versus yearly data and the period of analysis may also be of importance. In principle it seems reasonable to start with a general specification as possible. A natural point of departure may be a relation of the form:

$$Y_t - Y_{t-1} = \alpha + \beta t + (\rho-1)Y_{t-1} + \sum_{j=1}^{n} \rho_j (Y_{t-j} - Y_{t-j-1}) + \varepsilon_t$$

Under the assumption H_0 about non-stationarity $\rho=1$, which means that the variable Y_t is intergrated of order 1.

In testing $\rho=1$ it is important to be aware of that the coefficient for Y_{t-1} and its standard deviation may depend on the constant term and the trend. As pointed out by Dickey (1984) a test for $\rho=1$ when $\alpha=\beta=0$ may be weaker in a specification where α and β are included than in a specification where they are excluded. On the contrary when $\alpha\neq0$, $\beta\neq0$ a test for $\rho=1$ will have more strength when α and β are included rather than excluded. It therefore seems reasonable to have a test strategy where also $\alpha=0$ and $\beta=0$ are checked. One possible strategy may be to check first if $\alpha=0$ and $\beta=0$, both separately and simultaneously, in a specification where $\rho=1$. Regarding of rejection or not of these hypothesises, $\rho=1$ may be tested in the chosen specification. This procedure seems to give the strongest test for non-stationary when also α and β are taken into account.

Table I.1 shows the results of stationarity tests for the most important variables regarding wage formation giving the t-statistics. The results of the tests for α and β are also presented indicating if these coefficients are equal to 0 or not. In all the tests the number of lags on $Y_{t-1} - Y_{t-j-1}$ are fixed to 2 and are not tested.

Rather surprisingly the relative change in wage rates does not seem to be stationary contradicting the assumptions made by Nymoen (1990) in his discussion of the four windows presented above. From economic theory one should however expect that $\Delta W/W$ was I(0), and there may be some special events in the period 1966-1987 which causes wage growth to look non-stationary over that period. One explanation may be rather large wage increases during the middle of the seventies. As a result of the shortening of the normal working hours in 1987 the growth in hourly wage rates was rather strong also in that year. On the other hand wage growth was relatively moderate during the price and income freeze in 1979.

The rate of unemployment also shows up to be non-stationary in the period of analysis reflecting a substantially larger rate of unemployment in the eighties compared to the sixties and the seventies, although unemployment was relatively low in 1987. Based on quarterly data, Nymoen (1990) finds that the rate of unemployment is stationary over roughly the same period. One reason for this may be that quarterly data allows for a greater number of observations, and the tests may have more power than based on yearly data.

Table I.1. Dickey-Fuller tests for stationarity of variables regarding wage formation

Variable	t-statistics*)	α	β	Period
$\Delta W_t/W_{t-1}$	-0.12	0	0	1966-1987
$\Delta W_t/W_{t-1} - \Delta W_{t-1}/W_{t-2}$	-2.94	0	0	1967-1987
U	0.16	0	0	1965-1987
$1/U^2$	-0.63	0	0	1965-1987
$U_t - U_{t-1}$	-3.23	0	0	1966-1987
COMP	2.03	0	0	1965-1987
log(COMP)	-2.29	0	0	1965-1987
$\Delta COMP_t/COMP_{t-1}$	-2.84	0	0	1966-1987
WEDGE	-0.27	+	0	1965-1987
log(WEDGE)	-1.14	+	0	1965-1987
$\Delta WEDGE_t/WEDGE_{t-1}$	-1.81	0	0	1966-1988

*) A 5 per cent critical value for T=25 is reported to -1,95 in Fuller (1976).

W - nominal hourly wage rate for employees in mining and manufacturing according to the National Accounts

U - the rate of unemployment in the whole economy according to the Labour Force Sample Survey

COMP - indicator for competitiveness for mining and manufacturing exclusive petroleum refining

$COMP = W(1+\bar{s})/(P_I Z)$ where

$\bar{s}$ - average pay-roll tax rate for mining and manufacturing

P_I - price index on competing imported manufactured products (excl. refined petroleum products) according to the National Acconts

Z - value added per man hour in mining and manufacturing exclusive petroleum refining according to the National Accounts

$WEDGE = (1+\bar{s})/(1-\bar{t}) \cdot (P/P_I)$ where

$\bar{t}$ - average income tax rate

P - official consumer price index

In the long run it is however likely that also the rate of unemployment is a stationary variable. This is in favour of the Phillips curve approach. The rate of unemployment may help to explain wage formation in a situation where both U and $\Delta W/W$ are I(0). From a time series point of view U may also be a relevant factor over the period of estimation where both variables seem to be I(1). Theoretically this is more doubtful, and the

explained by large growth in wages and not vice versa.

Some of the arbitrariness in the tests of stationarity shows up in the analysis of the time series properties of competitiveness. While competitiveness is clearly non-stationary, the logarithm is not. In the latter case there is however a large constant term (but not significant), and where this term is included also the logaritm of competitiveness is non-stationary. It may then be fair to say that competitiveness is I(1) over the period of analysis, and also this contraticts the results found by Nymoen (1990). Use of other data showing a smaller loss in competitiveness than the data used in table I.1 may explain this. From economic theory it may also seem reasonable that competitiveness is I(0). As oil extraction has become an important exposed sector in Norway during the seventies and the eighties there is however no reason why the traditional exposed sectors like mining and manufacturing should keep up competitiveness during this period.

As both the competitiveness and the rate of unemployment seems to be I(1) over the period of analysis, we are in window iv) outlined by Nymoen (1990). If wage growth had been I(0) both the variables might look irrelevant on the right hand side unless they were cointegrated. However because wage growth is I(1) over the period of analysis both factors may be relevant.

As pointed out by Nymoen (1989 and 1990) the wedge variable may explain wage growth partly because of increasing tax rates, but mostly because of Norwegian consumer prices increasing more than competitive foreign prices. The term $c_9(s_{t-1}-t_{t-1}+p_{t-1}-p_{It-1})$ is therefore often included as an additional variable in the general equation 4.1. From table I.1 it seems that the change in the wedge is on the border of being non-stationary. As the wedge then at least is I(1) it may be a relevant factor explaining the loss in competitiveness, and the share and the wedge terms may cointegrate. An increase in the rate of unemployment may however have contributed to limit the loss in competitiveness during the eighties.

Although the power of stationarity tests may not be too great and the tests may be somewhat arbitrary regarding the specification of the variables and choice of yearly versus seasonally data, these tests may be important in choosing the most relevant explanatory factors. A single I(0) variable is not a relevant factor explaining the long term movement in a I(1) variable and vice versa. If two I(1) variables are cointegrated they may however explain a I(0) variable.

Some theoretical underpinning is however necessary to choose the most relevant variables. An important limitation in the time series analysis which has shown up in this appendix is that the theoretically long term properties of some variables may not show up even over a period more than 20 years. While one should expect both the rate of unemployment, the degree of competitiveness and wage growth to be I(0) variables, they all seem to be I(1). This may be due to some kind of arbitrariness in the choice of period of analysis, as a I(0) variable may show a substantial increase over some periods outweighed by a fall in other periods. There may however occur structural changes in the economy which may lead to a lasting shift in the level of a I(0) variable showing up as temporary non-stationarity. More structural problems at the labour market as analysed in chapter 3 may explain some part of the growth in unemployment, while the use of the incomes from oil extraction causing growth in the service sector, implicating pressure on the labour market, may explain the loss in competitiveness for traditional manufacturing industries.

Changes in some of the other variables may also have lasting effects on the wage level. The rather large and instant shortenings of the normal working hours in 1968, 1976 and 1987, the income regulations in 1978/79 and 1988/89 may have influenced the wage level.

APPENDIX II. MISSPECIFICATION TESTS FOR THE PHILLIPS CURVE

To evaluate the Phillips curve specification (3) reported in table 4.1 further, tests for misspecification, autocorrelation, heteroscedasticity, normality in the residuals and parameter stability may give useful indications of the appropriateness of the relation. In addition to these tests recursive estimates may give a good indication of parameter stability. The most important test statistics are presented in table II.1.

Table II.1. Misspecification test for the Phillips curve

Test	Test statistics	Probability
ARCH	$F(1,12) = 0.96$	0.35
AUTO	$F(1,13) = 0.00$	0.98
GOFF	$F(1,12) = 0.00$	0.98
NORMBJ	$\chi^2(2) = 0.14$	0.93
CHOW	$F(2,12) = 79991$	0.00

Heteroscedasticity in the residuals of 1st order is tested by a ARCH-test reported by Engle (1982). The hypothesis H_0: "No heteroscedasticity" may not be rejected.

A Durbin-Watson statistic of 1.85 reported in table 4.1 indicates no problems with serial correlation in the disturbance terms or other types of misspecification. This result is confirmed by both the AUTO-test and the GOFF-test. The AUTO-test is a Lagrange multiplier test for autocorrelation presented by Kiviet (1986). The test statistic shows no indication of serial correlation of the 1st order. The same is true for the GOFF-test (Godness of Fit, see Harvey (1982), p. 277).

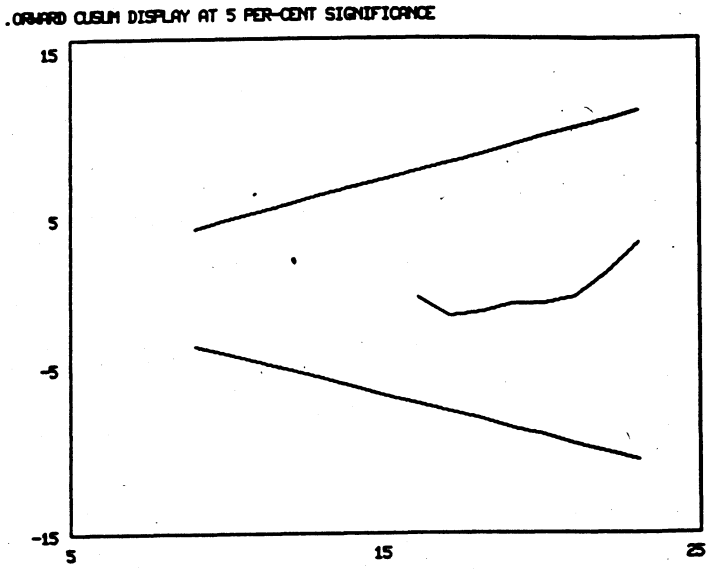
As OLS-results are based on the assumption of normality in the residuals, a Bera-Jarque test for normality (see Spanos (1986)), named NORMBJ, is carried out to test the assumption H_0: The residuals have a normal distribution with no skewness and no excess curtosis. This hypothesis is neither rejected.

The sub-sample CHOW-test (see Chow (1960)) reported in table II.1 indicates that a structural change may have occured in the period after 1985. This is confirmed by the CUSUMSQ test shown in figure II.1. (see Harvey (1982), p. 151-154)) although the CUSUM-test seems to behave well.

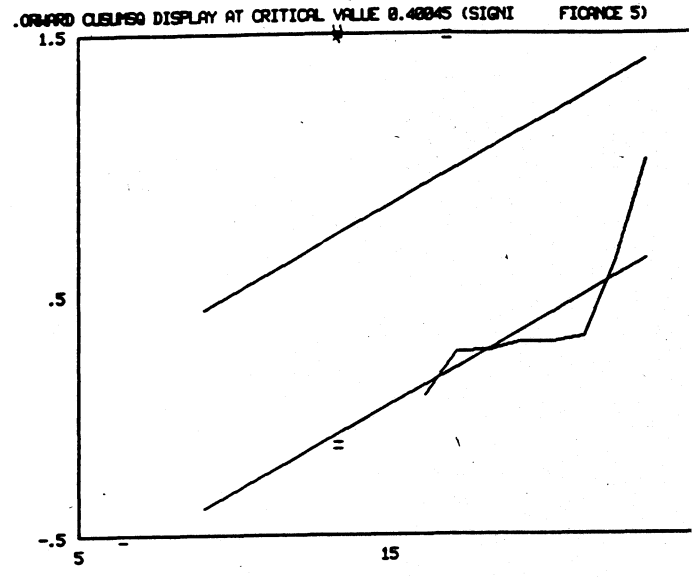
While the CUSUM-observator is based on the sum of recursive residuals, the CUSUMSQ-observator is based on the cumulative squared sum of residuals in a recursive estimation. If the model is incorrectly specified, there may be a tendency for a disproportionate number of recursive residuals to have the same sign, moving the CUSUMobservator away from the horizontal axis. The two lines drawn symmetrically above and below the axis provide a means for assessing the significance of departure. When the curve for the CUSUMSQ-observator also crosses some of the two significance lines, this may indicate a structural break. From figure II.1 it looks like the main problems arise in 1987 as there is a large jump in the CUSUMSQ-observator in that year.

Figure II.1. CUSUM- and CUSUMSQ-statistics for recursive estimations of the Philips-curve at 5 per cent significance level

CUSUM-observator



CUSUMSQ-observator



To check the problems with parameter stability further, recursive estimations for all the coefficients in the Phillips-curve specification are presented in figure II.2. Except from the constant term and the coefficient for unemployment, the other coefficients are rather stable from 1981 to 1986, but change considerably in 1987. The shortening of the normal working hours seems to be the main reason behind this, having a larger impact on wages in 1987 than was the result of the other main shortenings in 1968 and 1976. It may be a problem with the shortenings of normal workinghours that they occur at discreet jumps, and the long run effect may

be smaller than the short run effect. As a result of the income regulation in 1988 and 1989 the period of estimation is not extended beyond 1987. This regulation may have been initiated by the large wage increases as a result of the shortening of normal working hours.

The change in the impact from normal working hours has also affected the other coefficients. However, this regards only the short run dynamics. The long term restrictions regarding homogeinity for prices and productivity seem to be valid irrespective of whether 1987 is included in the period of estimation or not.

Neither the constant term nor the coefficient for unemployment seem to be much affected by the shortening of the normal working hours. Both these variables were rather imprecise before the increase in unemployment in 1983/84, but afterwards the standard deviations have declined substantially. However, the recursive estimation indicate that these variables do not reach a stable value even up to 1987. The absolute value of both coefficients have declined during the eighties, but the constant term relatively more than the coefficient for unemployment, indicating an increasing natural rate of unemployment in accordance with the discussion in chapter 3.

Figure II.2. Recursive estimations of the coefficients in the Phillips-curve

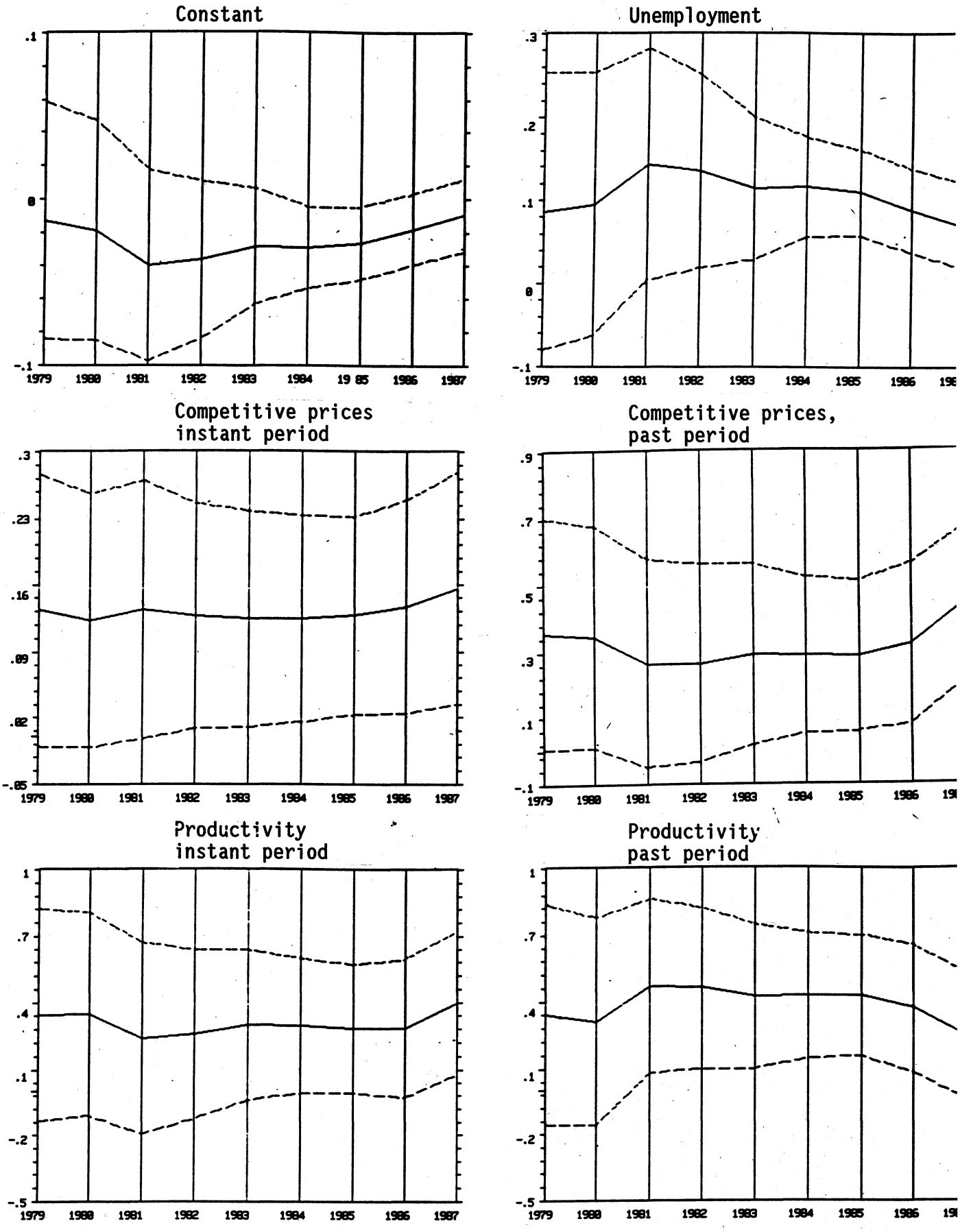
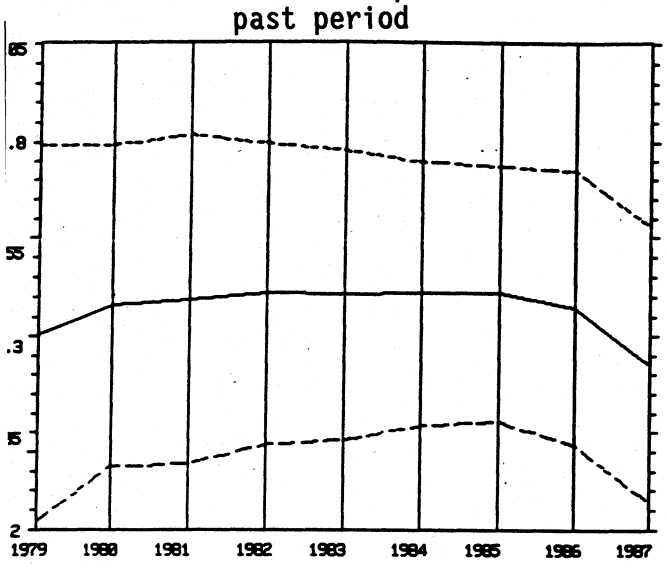
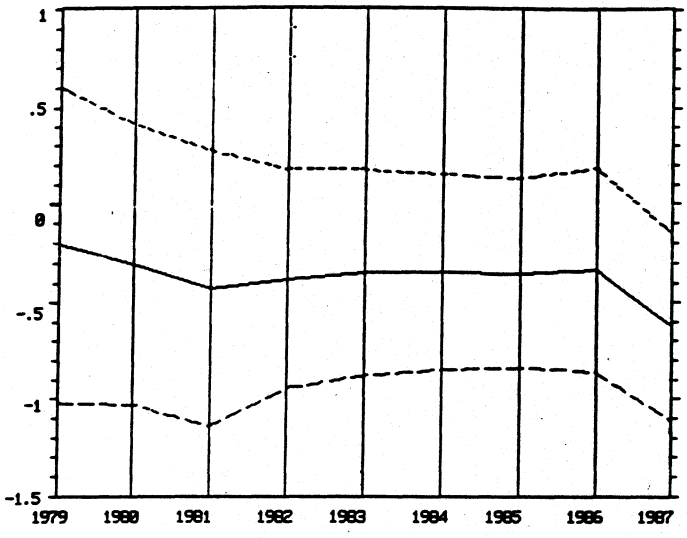


Figure II.2. (cont.)

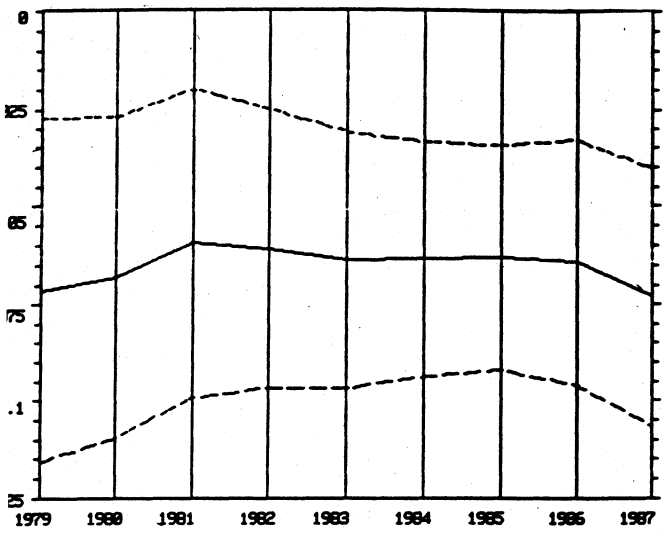
Consumer prices past period



Normal working hours



Wage and price freeze 1978/79



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