Measuring structural unemployment: Is there a rough and ready answer?

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First version: March 12th 1998.
This verson: December 18th 1998, comments welcome.

Abstract

In recent years, the OECD has measured the structural rate of unemployment by an indicator called the Non-Accelerating Wage Rate of Unemployment. The *NAWRU*-indicator is an important element in the policy analysis of the OECD. The rise in the estimated *NAWRUs* is also taken as evidence that Nordic unemployment, as well as unemployment in the rest of Europe, has increased due to a malfunctioning of labour markets. The paper presents stable empirical wage equations for Denmark, Finland, Norway and Sweden over the period 1964-1994, in sharp contrast to the increased NAWRU-estimates. The instability of the NAWRU-estimates appears to be the product of a misspecified underlying wage equation, and not due to instability in the wage setting itself.

Keywords: Structural unemployment, NAWRU indicator, econometric wage equations, stability, Nordic wage formation.

*We would like to thank Jørgen Elmeskov, Anders Forslund, Asbjørn Rødseth, Tore Thonstad and Anders Vredin for discussion and comments and Colin Forthun for research assistance. The authors take the whole responsibility for the views expressed and for any errors that might exist. An earlier version of this paper was presented at the European Meeting of the Econometric Society, Berlin, August 30th-September 2nd 1998. All numerical results were produced by PcGive 9.0, see Doornik and Hendry (1996). The authors are professors of economics at the University of Oslo. Please address correspondence to either of the authors at the University of Oslo, Department of Economics. P.O. Box 1095 Blindern. N-0317 Oslo, Norway. Internet: steinar.holden@econ.uio.no or ragnar.nymoen@econ.uio.no.

1 Introduction

Over the last 25 years, the rate of unemployment in Europe has risen dramatically. A large number of different explanations have been suggested (cf. surveys in Bean (1994), and OECD (1994)). Although no general agreement has emerged, there appears to be a widespread belief that the rise in unemployment can be attributed to a malfunctioning labour market. More precisely, the rise in unemployment is viewed to be mainly structural, reflecting a rise in the equilibrium or natural rate of unemployment (see e.g., OECD (1994), page 73, or Krugman (1994)). But for policy purposes, this view is too vague, and there is a demand for more precise conclusions. To meet this demand, the OECD has in recent years measured the structural rate of unemployment by use of a specific indicator, the *NAWRU* (Non-Accelerating Wage Rate of Unemployment) indicator, suggested first by Elmeskov and MacFarland (1993) and Elmeskov (1994). Crudely, this indicator measures the structural rate of unemployment as the rate of unemployment at which wage growth is stable.

In the years since it was first constructed, the NAWRU-indicator has gained in importance. It is applied by the OECD and others to several important issues. First, it is used in the calculation of output gaps by OECD, as it is a crucial element in the estimate of the potential output (Giorno et al. (1995)). Second, the NAWRU-indicator is important in the construction of OECD's data for General government structural balance, as these are also based on the estimate on potential output. Third, the NAWRU-indicator is used as a measure of the structural (or equilibrium) rate of unemployment, e.g. Elmeskov (1994), Ball (1996) and Elmeskov et al. (1998). *NAWRU*-indicators for the different countries typically follow the actual rate of unemployment rather closely, and leaves little room for cyclical unemployment. Thus, the rise in unemployment appears to be explained by a rise in structural unemployment as measured by the *NAWRU.* In sum, there is little doubt that the NAWRU-indicator forms an important piece of evidence behind the general view that a large part of European unemployment is structural, as in OECD (1994).

The main advantage of the *NAWRU*- indicator is its simplicity of construction, with limited use of data, and that it is motivated by the theoretical framework on equilibrium unemployment that has been adopted in most studies on European unemployment in recent years, e.g. Layard and Nickell (1986) and Layard et al. (1994). Furthermore, it provides simple and seemingly exact answers to important and difficult problems. However, there are good reasons to be sceptical towards the answers that the *NAWRU* provide. The simplicity and limited use of data also involve important weaknesses: Important explanatory variables are omitted, there is no estimation, and therefore no test statistics or statistical measures of the uncertainty associated with the indicator itself.

While these objections are all valid in theory, do they matter in practice? We explore this issue within an empirical analysis of the evolution of hourly wages in the manufacturing sector in the four major Nordic countries, Denmark, Finland, Norway and Sweden. In all these countries, unemployment has risen since the early 1970s, first in Denmark, more recently in the other countries. For all countries, the *NAWRU*-estimates indicate a corresponding increase in structural unemployment. One is led to the conclusion that the rise in unemployment is associated with a structural change in the labour market. However, when we explore the wage setting behaviour empirically, we find no evidence of structural breaks in wage-formation. For all countries, we obtain an empirical wage equation that is stable over the period 1964-1994 (Denmark for 1968-94). The instability of the *NAWRU*-estimate appears to be a product of a mis-specified underlying wage equation, and is not due to instability in the wage setting itself.

An immediate objection to this argument is that the empirical wage equation includes variables that affect the structural rate of unemployment and that there is no inconsistency between finding a wage equation with stable coefficients and instability in the *NAWRU*-estimate. For example, if unemployment benefits increase, this is likely to raise the structural rate of unemployment, and thus also the *NAWRU*, but it would not affect the stability a wage equation where unemployment benefits are included. However, according to our wage equations, there is no indication that wage pressure has risen as a result of more generous benefit systems, or of other developments that increase the structural rate of unemployment through wage setting.

Our empirical analysis is confined to the manufacturing sector, owing to the availability of high quality data for this sector for all countries. In principle, although we show evidence of stability in manufacturing wage formation, it is a possibility that changes in wage setting elsewhere can explain the instability of the *NAWRU*s calculated for a wider aggregate (the OECD report *NAWRU*s for "the business sector"). At the end of the day, we do not think that this is an issue. First, the manufacturing sector *NAWRU*s that we calculate show a striking similarity to OECD's business sector *NAWRU*s, indicating that instability on the whole is the result of the method used, not the sector that is investigated. Secondly, the manufacturing sector includes both white and blue collar workers, skilled and unskilled, so that a large shift in demand or supply affecting one of these categories would be present in our data. Thirdly, a recent econometric study of total economy wage formation in Norway shows no evidence of a structural break, Bårdsen et al. (1998).

The novelty of our argument does not lie in the view that the *NAWRU*-indicator is an imperfect measure of structural unemployment; this view is already acknowledged. In early work on the *NAWRU*-indicator, Elmeskov and MacFarland (1993) are careful in their interpretation of the evidence. They gave due attention to an alternative explanation that there is slow adjustment to the long-run equilibrium rate of unemployment. Moreover, they emphasized that, in case wage growth depends on the change in unemployment as well as the level, the *NAWRU*-indicator corresponds to the short-run equilibrium rate of unemployment, and not the long run. However, as far as we know, the *NAWRU*-indicator has not previously been subject to a systematic empirical evaluation. In policy analysis and general discussions, the uncertainty and caution is often forgotten. In the applications of the NAWRU-indicator mentioned above, there is often no reference to the NAWRU-indicator being a short-run concept. Thus, in spite of the serious weaknesses, the *NAWRU*-indicator plays a vital role in important policy discussions.

While the main issue of our paper concerns the weaknesses of the *NAWRU*-indicator, we also want to emphasize that our empirical investigation has broader implications as well. Most explanations given in the literature for a rise in structural unemployment would in fact result in instability in the estimated wage equation. This would be the case if the rise in unemployment is caused by adverse structural changes in the labour market (such as stronger or more aggressive unions). It would also be the case if the rise in unemployment is caused by adverse demand shocks, but subsequently turned in to higher structural unemployment due to hysteresis in the form of, say, reduced job motivation and capability of long-term unemployed (see e.g. Layard et al. (1991)). In fact, we show in the appendix that instability in the aggregate wage equation would be a consequence also if the increase in aggregate unemployment arises from a shift in demand from unskilled to skilled labour (a popular explanation in recent years, see e.g., Juhn et al. (1991)), even if the wage equations of each group itself is stable.

Note that, we do not argue that our findings imply that structural unemployment has not risen in the Nordic countries, not to say elsewhere in Europe. Our finding of a stable wage setting behaviour is consistent with a rise in structural unemployment if the price setting behaviour has changed, see the discussion in section 6 below. However, we do think that our findings indicate that one should be cautious in drawing conclusions about the causes of the rising unemployment in the Nordic countries, and perhaps also for the rest of Europe.

Part of the explanation of the success of the $NAWRU$ -method lies in its simplicity. The equilibrium unemployment level is measured by a simple indicator that is based on only wage growth and unemployment. One lesson from our study is that this represents an oversimplification that distorts the interpretation of the evidence. In contrast, we would say that since we only address wage setting, our empirical results cannot be used to estimate the structural rate of unemployment. However, we suggest measures of wage pressure based on our estimated wage equation. By themselves, they provide evidence on whether changes in the wage setting have taken place that result in a higher structural rate of unemployment (as alluded to above, we do not detect any such changes). In principle, these measures can be used in combination with similar measures on price setting behaviour to obtain estimates on the structural rate of unemployment.

The paper is organized as follows. Section 2 describes the basic theoretical framework for recent empirical wage equations, as well as for the $NAWRU$-indicator. The $NAWRU$-indicator is defined and constructed for the Nordic countries in section 3, which also shows why one might be doubtful about the information carried by the $NAWRU$ estimates about structural labour market phenomena. Against that background, the wide usage of the $NAWRU$ that is documented in section 4 is worrying. The empirical stability of the Nordic wage equations are presented in section 5, substantiating our argument that the $NAWRU$ method may result in invalid inference regarding wage setting. Section 6 concludes.

2 Theoretical framework

This section provides a brief description of the basic theoretical framework, which is the same for both the $NAWRU$-indicator and our empirical wage equations. More elaborate treatments are given in Layard and Nickell (1986) and Layard et al. (1991), a textbook presentation is provided in Carlin and Soskice (1990), whereas Kolsrud and Nymoen (1998) contrast the properties of the static model with a dynamic model of wage and price setting.

The underlying framework is an economy with imperfect competition in both product and labour markets— therefore Carlin and Soskice (1990) refer to this as the Imperfect Competition Model, ICM. Wages are set in negotiations between workers/unions and firms, or unilaterally by the firms. (The subsequent discussion is related to a bargaining framework, as union bargaining is widespread in the Nordic countries, as well as in the rest of Europe, but a similar relationships could be derived in an efficiency wage framework, see e.g. Layard et al. (1991).) Firms are faced with downwards sloping demand functions in the product markets, and set their prices so as to maximize profits. The rate of unemployment affects both wage and price setting, and the equilibrium rate of unemployment is determined by the requirement that the wage and price setting must be consistent, in the sense that in equilibrium, the real wage that is the result of the wage setting must be identical to the real wage that results from price setting.

Formally, we define the producer real wage $w_{q,t}$, as

$$w_{q,t} = w_t - q_t = \log(W_t/Q_t), \tag{1}$$

where w_t is the nominal wage in period t, and q_t is the value added price of domestic products. Lower case letters indicate logarithmic scale, i.e., $w_t = \log(W_t)$. The outcome of the wage setting see e.g. Nickell and Andrews (1983), Hoel and Nymoen (1988) is

$$w^w_{q,t} \;=\; b_0 + b_1(p_t - q_t) - b_2\, u_t + b_3 z_t,\;\; 0 \le b_1 \le 1,\;\; b_2 \ge 0, \tag{2}$$

where p_t is the consumer price and u_t is the (log of the) rate of unemployment and z_t represents other possible variables that may affect wage setting (tax rates, productivity, etc., see section 5 below). The producer real wage is decreasing in unemployment (u_t), reflecting that the bargaining position of the workers is stronger, the lower the rate of unemployment. The positive (if $b_1 > 0$) effect of the term ($p_t - q_t$) (frequently referred to as the wedge) reflects that workers demand a compensation to keep up the purchasing power if consumer prices increase. This phenomenon is called real wage resistance.

The consumer price is given by

$$p_t = \phi q_t + (1-\phi) pi_t, \quad 0 < \phi < 1, \tag{3}$$

where pi_t is the price index of imported goods and ϕ is an increasing function of the share of imports in consumption.

Profit maximization implies that firms set prices as a markup on the marginal costs, where the markup depends on the price elasticity of demand. Wages are an important factor in the marginal costs, and the outcome of the price setting is a producer real wage $w^f_{q,t}$. A common procedure in this literature (see e.g. Layard et al. (1991)) is to assume that movements in the mark-up on labour costs depend on the level of competitiveness and the rate of unemployment

$$w^f_{q,t} \;=\; a_0 - a_1(p_t - q_t) + a_2 u_t, \quad a_1,\; a_2 \ge 0. \tag{4}$$

The negative effect of the wedge is based on the assumption that the price elasticity is decreasing in international competitiveness, so that, say, a rise in import prices increasing the wedge leads to higher prices on domestic goods, thus reducing the producer real wage. The positive effect of unemployment may reflect two different mechanisms: (i) higher unemployment is associated with lower employment, leading to higher marginal productivity (assuming decreasing returns to scale), lower prices, and thus a higher real wage; (ii) higher unemployment is associated with lower demand, implying stronger competition in the product market and thus lower mark-ups and a higher real wage (Layard et al. (1991)).

If no expectations errors are made, and there are no rigidities in the wage and price setting, equations (2) and (4) will hold exactly. As there is only one producer real wage in the economy, we then have $w_q^w = w_q^f$. Using equations (2) and (4), we can solve for the equilibrium rate of unemployment,

$$U^{ICM} = \exp(\frac{-a_0 + b_0}{(a_2 + b_2)} + \frac{a_1 + b_1}{(a_2 + b_2)}(p - q)). \tag{5}$$

In the ICM literature, it is acknowledged that due to expectations errors and nominal rigidities, the wage and price setting equations (2) and (4) need not hold exactly. In this case the actual rate of unemployment may deviate from the equilibrium rate given by (5). If, say, inflation exceeds the rate that is expected in the wage setting, actual real wages may fall below the value indicated by the wage curve (2). More generally, unemployment below U^{ICM} is associated with inflation being below the expected rate, while unemployment above U^{ICM} is associated with inflation being above the expected rate. A common assumption in the literature (e.g.Layard et al. (1991)) is to assume that expected inflation is equal to inflation in the previous year, so that inflation surprises correspond to changes in the rate of inflation. On this assumption, U^{ICM} corresponds to the NAIRU.

Note that the equilibrium rate of unemployment U^{ICM} depends on the wedge $(p - q)$, if $a_1 + b_1 > 0$. The equilibrium rate given in (5) is thus sometimes referred to as the medium term equilibrium rate of unemployment, referring to the fact that the wedge $(p - q)$ itself is an (economy) endogenous variable. In this case an additional constraint is required to pin down a unique long run equilibrium rate of unemployment.

Several alternative constraints are possible. First, Layard et al. (1991) focus on a trade balance constraint, on the observation that the trade balance is increasing in the rate of unemployment (as higher unemployment is associated with lower output and income, and thus lower imports) and decreasing in the wedge (a larger wedge is associated with a deterioration of cost competitiveness). Imposing balanced trade in the long run thus uniquely determines the equilibrium values of both unemployment and the wedge. Second, Holden (1997) observes that if there is constant returns to scale in labour and capital, and capital is endogenous in the long run, the wedge (and thus also the equilibrium rate of unemployment) is uniquely determined by the required return to capital. Third, Layard et al. (1991), chapter 1, argue that real wage resistance probably does not last forever. In the long run, the wedge does not affect wage and price setting, $a_1 + b_1 = 0$, and the static model determines a unique equilibrium rate of unemployment.

For our purposes, it is not necessary to choose between these alternative constraints. To the contrary, we want to argue that all these constraints are likely to require long time to work. So while one cannot expect expectations errors and

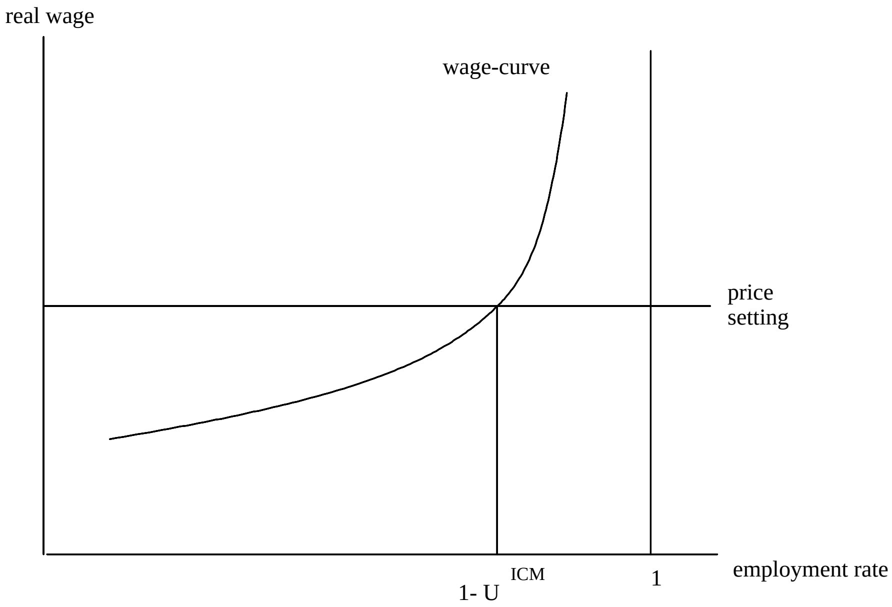

Figure 1: Equilibrium unemployment, U^{ICM}.

nominal rigidities to have long lasting effects, and thus (within this theoretical framework) cannot expect actual unemployment to deviate for long periods from U^{ICM}, the equilibrium rate given in (5), one can expect U^{ICM} itself to have long-lasting fluctuations associated with variation in the wedge. Thus, in an open economy, the uniqueness of the long run equilibrium rate of unemployment may indeed only apply in the very long run.

Figure 1 illustrates the determination of the equilibrium rate of unemployment as the intersection between a price curve and a wage curve in the employment - real wage space (for simplicity, the figure is based on constant labour supply and no effect of unemployment on price setting, i.e. $a_2 = 0$). If, say, the wedge increases, the wage curve will shift to the left, and the price curve will shift downwards, both changes increasing the equilibrium rate of unemployment U^{ICM}.

For later reference, we also want to briefly observe the consequences of a particular form of hysteresis within this framework. Consider hysteresis of the outsider type, which often viewed as an important source of persistence in European labour markets (e.g.Bean (1994)). The idea is that the unemployed gradually loses their effectiveness as job searchers, because of a reduction in skills or motivation, or because firms for some reason are reluctant to hire them. If unemployment is high over some time, a share of the unemployed will lose their impact on wage setting, and a higher rate of total unemployment is required to keep wage pressure down. In other words, the wage curve shifts to the left, and equilibrium unemployment increases.

3 Empirical *NAWRU* estimates for the Nordic countries

The NAWRU-indicator is based on the idea that actual unemployment being below equilibrium unemployment is associated with inflation being above its expected value. The method focus on the wage setting, and thus inflation expectations are represented by the money wage growth of the previous year. In other words, money wage growth rises if and only if unemployment is above its equilibrium value. To be more precise, Elmeskov and MacFarland (1993) and Elmeskov (1994), define the non-accelerating wage rate of unemployment, *NAWRU*, in terms of a stylized wage-pressure equation

$$\Delta wg_t = -c_1(U_t - U_t^{NAWRU}),\ c_1 > 0 \qquad (6)$$

where $wg_t = \Delta w_t$ denotes the rate of money wage growth in period t, Δ is the first difference operator and U_t is the rate of unemployment and U^{NAWRU} is the *NAWRU*. In words, it is assumed that wage inflation is affected in a linear way by the difference between the actual level of unemployment and the *NAWRU*. If U^{NAWRU} is considered a constant parameter, it could be estimated in the usual way, for example by rewriting (6) as $\Delta wg_t = c_0 - c_1 U_t$ and basing U^{NAWRU} on the estimated parameters $\hat{c}_0$ and $\hat{c}_1$ (i.e. $\hat{U}^{NAWRU} = \hat{c}_0/\hat{c}_1$), see e.g. Staiger et al. (1997). However, as U_t^{NAWRU} is fundamentally time dependent, (6) cannot be estimated directly. Instead, (6) is used to calculate the parameter c_1, for each observation separately, based on an assumption that U^{NAWRU} is unchanged between two consecutive observations, namely

$$c_{t1} = -\Delta^2 wg_t/\Delta U_t. \qquad (7)$$

Substituting the observation dependent parameter values c_{t1} back into (6), the *NAWRU* is calculated as:

$$U_t^{NAWRU} = U_t - (\Delta U_t/\Delta^2 wg_t)\Delta wg_t. \qquad (8)$$

The raw *NAWRU*-estimates as given by equation (8) are very volatile, see figure 2, so published *NAWRU*s are based on Hodrick-Prescott filtering of these raw *NAWRU* estimates. Figure 3 records the *NAWRU*s that are cited in policy analysis discussions, see OECD (1997a) , Economic Surveys for Norway and Sweden.

The construction of the *NAWRU*-indicators is thus based on a simple method, that captures the basic idea of the theoretical framework (that wage growth rises if unemployment is above its equilibrium level) in a neat way. However, real-world wage setting is not neat, and the problems associated with the *NAWRU*-indicator are apparent at each step of its construction. First, according to theory, the effect of unemployment on wage growth is negative (c_1 is positive). In practice, however, wage growth and unemployment sometimes move in the same direction, rendering $c_{t1}$with the wrong sign. In fact, in our sample this is the case for about one third of the observations for Denmark, Finland and Norway, and more than half for Sweden. Secondly, as c_{t1} is computed as a fraction, where the denominator (the change in the rate of unemployment) may be close to zero, it is highly volatile. For Sweden, the calculated c_{t1} is close to zero for most of the observations, while in 1980, it is -25,

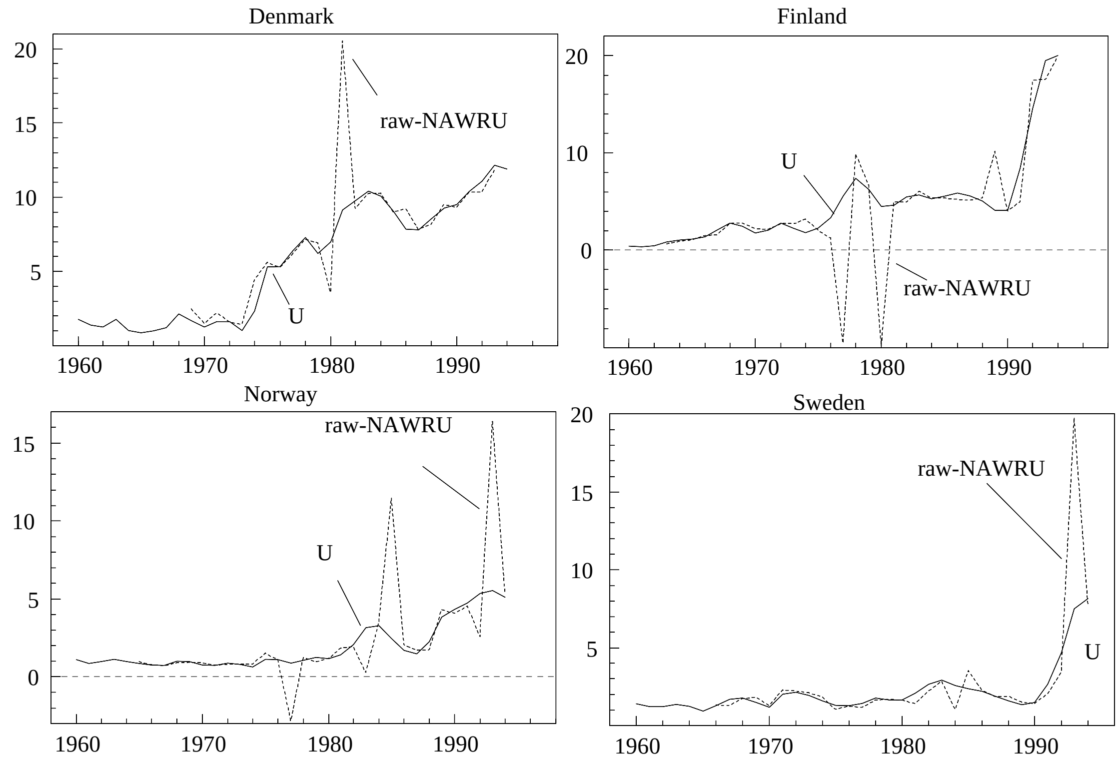

Figure 2: Actual rates of unemployment and "raw" NAWRUs for the four Nordic countries

reflecting that unemployment was almost constant from 1979 to 1980. The volatility of c_{t1} leads to a considerable volatility in the raw $NAWRU$-estimates.

As the $NAWRU$-indicator is not derived by standard estimation methods, it eludes most of the standard design tests; there are no R-squared, Durbin-Watson statistics, etc. However, this does not imply that the $NAWRU$-indicator cannot be subject to empirical evaluation. First, consider within sample prediction. In the calculation of the raw-$NAWRU$s, the parameter c_1 is allowed to vary from observation to observation, so there is always a perfect fit. Thus, to test the $NAWRU$ indicator, at least some additional assumptions are necessary. The weakest test is to check the sign of the predictions. Does money wage growth increase if actual unemployment is below the $NAWRU$? It turns out that for Norway and Sweden, the sign is wrong for about half of the observations; for Denmark and Finland the sign is wrong for more than one-third of the observations. This is illustrated in Figure 4, where the deviation of actual unemployment from the $NAWRU$ is plotted against the change in money wage growth.

We also tried to investigate the predictive power of the $NAWRU$-method within a standard regression framework, i.e. we estimated equation (6), by regressing Δwg_t on $(U_t - U_t^{NAWRU})$. This involves a further assumption compared to the $NAWRU$ framework, as it implicitly assumes that the parameter c_1 is constant over the sample period. On the other hand, assuming c_1 to be constant is not really in contrast to the idea that the structural rate of unemployment may fluctuate over time. The results are unequivocal. Deviations of actual unemployment from the

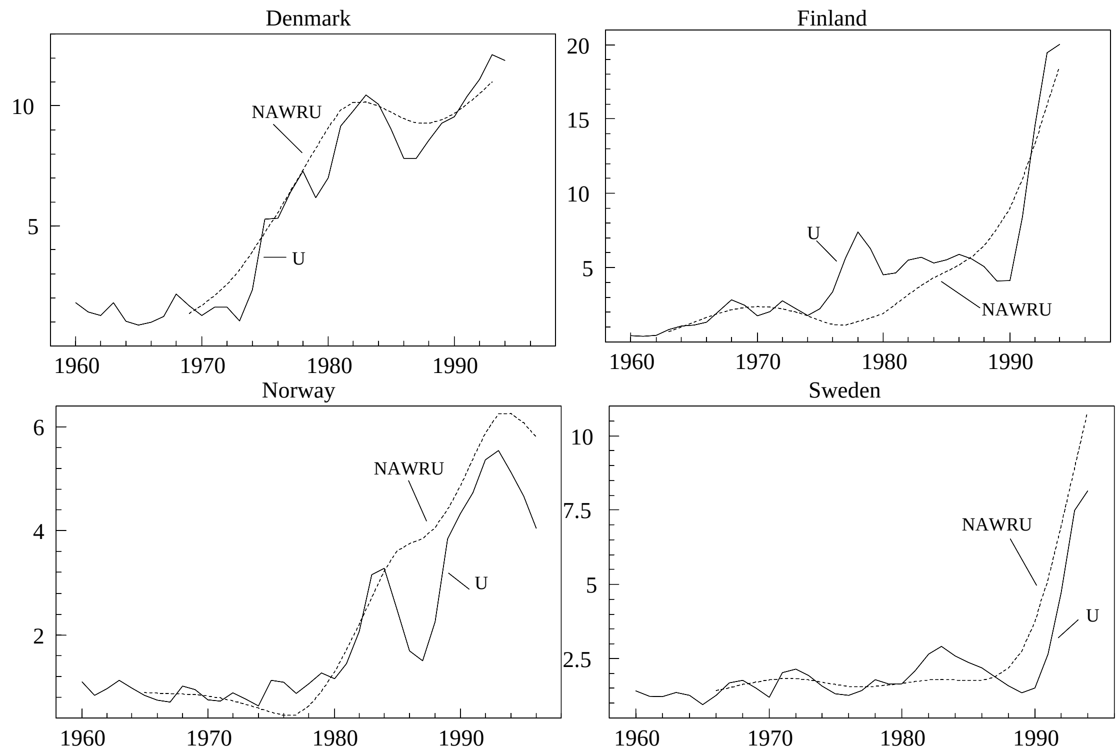

Figure 3: Actual rates of unemployment (U) and NAWRUs for the four Nordic countries.

$NAWRU$ are found to have virtually no predictive power for the change in wage growth. The ratio between the residual standard error of regression (6) and the variance of the Δwg_t series is above one for all countries except Finland where it is 0.995, hence the estimated $NAWRU$ equations explain nothing of the actual variation in the wage-acceleration.[1] Not surprisingly, the estimated c_1-coefficients are all ill-determined: Denmark 0.008 (1.00), Finland 0.003 (1.25), Norway 0.001 (0.21), Sweden 0.006 (0.76), the numbers in parentheses are "t-values". The average point estimate is 0.0037 and the average "t-value" is 0.7.

The second part of our empirical evaluation of the $NAWRU$-indicator concerns the exclusion restrictions. The $NAWRU$-indicator is based on an assumption that the change in the rate of wage growth is not affected by other variables than the deviation of actual from structural unemployment (as measured by U^{NAWRU}). This is not an innocuous simplification, rather it is crucial for the interpretation of the results. If an increase in the rate of wage growth were induced by a change in another explanatory variable, then the inference of the $NAWRU$-method, that actual unemployment is above structural unemployment, would be invalid. The significance of other explanatory variables that we document in section 5 thus provides strong evidence against the exclusion restrictions that the $NAWRU$-method is based on.

[1] The ratios are 1.023 (Denmark), 0.995 (Finland), 1.034 (Norway) and 1.005 (Sweden). Note that this ratio may exceed unity as there is no constant term in (6).

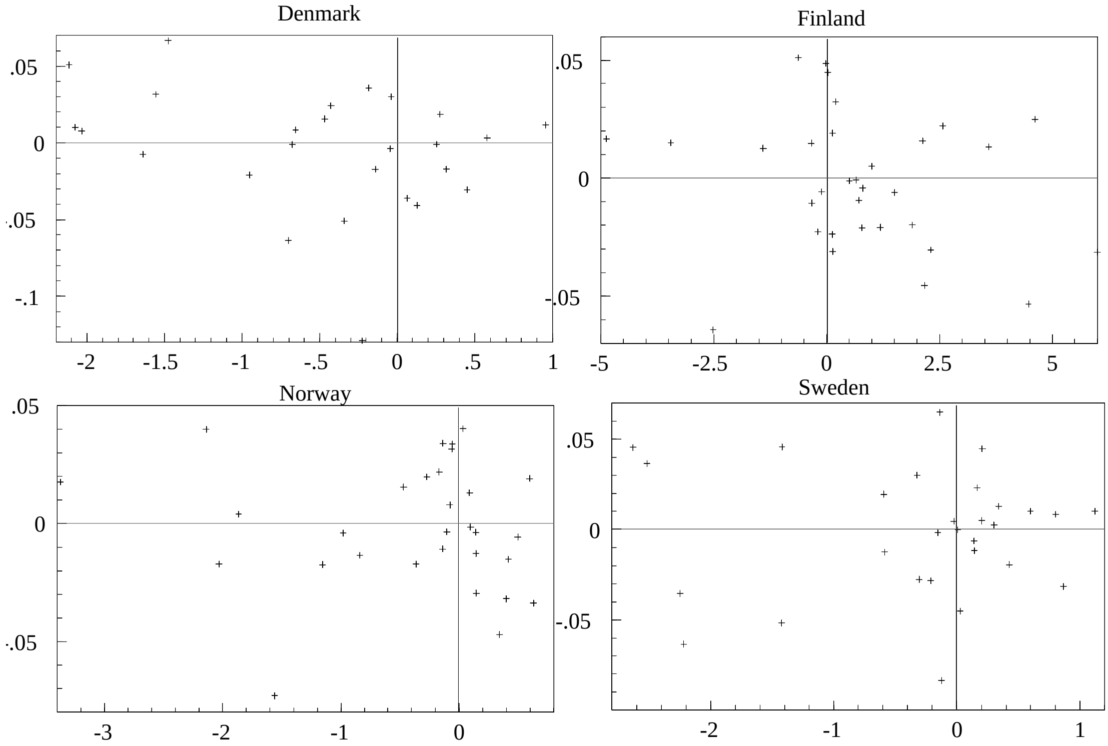

Figure 4: Cross plots of change in wage growth, Δwg_t (vertical axis) and $(U_t - U_t^{NAWRU})$ (horizontal axis).

4 The use of the NAWRU-indicator

As mentioned in the Introduction, the $NAWRU$ -indicator is applied by the OECD to many important issues. First, it is used in the calculation of output gaps by OECD, as it is a crucial element in the estimate of the potential output (Giorno et al. (1995).[2]. The output gap plays an important role in the policy analysis of the OECD; both at the methodological level (in OECD (1994), page 69, it is argued that "...estimates of cyclical unemployment or of output gaps can be used in deciding whether there is in principle the scope for macroeconomic policy to influence unemployment in the short run.") and in the policy analysis of individual countries (e.g. OECD Economic Surveys for Norway, 1998). It is also used by independent policy observers, (see e.g. the Economist 16 May 1998, page 85).

Second, the NAWRU-indicator is important in the construction of OECD's data for "General government structural balance", as these are also based on the estimate on potential output (cf.Giorno et al. (1995)). The structural budget balance is used for several different policy analyses. It is used as a measure of discretionary policy adjustment, in the sense that an increase in the structural budget deficit is

[2] In the construction of the output gaps, the elasticity of output with respect to labour is assumed to be equal to the wage share in the business sector, which is usually around 0.65-0.75 (Giorno et al. (1995)). Thus, if the $NAWRU$-estimate is one percentage point higher than the "true" equilibrium rate of unemployment, the estimate of the potential output will be 0.65-0.75 percentage points too low. As the output gap is defined as the difference between potential and actual output, the output gap will in this case also be 0.65-0.75 percentage points too low.

viewed as an indication of fiscal policy becoming more expansionary. The structural budget balance is also used as an indicator of the degree of stimulus that the government provides to aggregate demand. Finally, the structural budget balance is used to detect possible trends towards unsustainable public debt positions. In all these applications, a bias in the *NAWRU* - indicator may have important implications for the policy analysis. For example, if the *NAWRU* - indicator overestimates the true structural rate of unemployment, the structural budget balance will be weaker than the correct value, inducing a bias in the measure of discretionary fiscal policy. Moreover, in this situation the weak structural budget balance may be taken as an indication of the need of a tightening of fiscal policy, with the possible consequence that a strict policy actually makes a high unemployment that at first was cyclical become much more persistent.

Third, the NAWRU-indicator is used as a measure of the structural (or equilibrium) rate of unemployment in studies aiming at explaining the determinants of the structural rate of unemployment by the OECD (e.g. Elmeskov (1994), Elmeskov et al. (1998)) and others (e.g. Ball (1996)). Again, weaknesses of the *NAWRU*- indicator will also involve problems in the interpretation of the results of such studies, with the risk that misleading conclusions are drawn.

5 Econometric wage equations for the Nordic countries

Our starting point has been that the *NAWRU*-indicator in effect is based on a stylized wage equation. In this section we show that it is possible to derive stable and well-specified empirical wage equations for each of the Nordic countries. This suggests strongly that the instability of the empirical *NAWRU*-indicators is due to serious econometric misspecification, and not due to actual changes in the wage setting. Following Rødseth and Nymoen (1998) we estimate wage-equations of the form:

$$(9)\qquad \begin{aligned} \Delta wc_t &= \beta_0 - \beta_1 (wc - q - pr)_{t-1} + \beta_2 (p - q - at + pt)_{t-1} - \beta_3 tu_t \\ &\quad + \beta_4 lmp_t + \beta_x^{'} X_t + \varepsilon_t, \end{aligned}$$

where all variables have a time subscript t for calendar year and are measured in logarithms so that β_j $(j = 1, 2, \ldots 7)$ are elasticities and ε_t is a residual. The variables are defined as follows

$wc =$ log of hourly wage cost in manufacturing;

$q =$ log of index of value added prices;

$p =$ log of consumer price-index:

$pr =$ log of value added labour productivity;

$tu =$ log of the total rate of unemployment, i.e. the number of persons on labour market programmes is added to the number of openly unemployed, and then divided by the labour force;

$lmp =$ ln(open unemployment/total unemployment);

$pt =$ ln(1+ *tax rate on the use of labour);*

$at =$ ln(1− *average income tax rate)*

This equation relates wage growth to lagged *profitability* as measured by the wage share, $(wc-q-pr)$, the real-wage *wedge*, $(p-q-at+pt)$, *labour market* pressure (tu and lmp) and institutional features, and growth rates (captured by $\beta_x^{'}X_t$). Wage-equations of this type have a long history in econometrics and have been applied to a wide range of data sets, see e.g., Sargan (1964), Nymoen (1989a) and the studies surveyed in Drèze and Bean (1990). As mentioned, $\beta_x^{'}X_t$ is a composite term that encapsulates growth rates of the listed levels variables (e.g. Δp_t, Δq_t, Δpr_t and Δtu_t) as well as country specific determinants of wage-formation, heterogeneity that is not reflected in linear restrictions on the other elasticities. For example dummies for incomes policy, the length of the working day, unemployment insurance are all potentially important determinants of wages in the individual countries. Using two variables for labour market pressure (tu and lmp) in (9) encapsulates two specific hypotheses on whether individuals on labour market programmes have the same wage-dampening effect as the openly unemployed: *i):* only total unemployment matters: $\beta_4 = 0$; and *ii)*: Only open unemployment matters: $\beta_3 = \beta_4$, see Rødseth and Nymoen (1998) for a discussion.

For robust inference, it is necessary to consider the temporal properties of the data, i.e., whether there are non-stationary integrated variables. Estimation of a dynamic equation like (9) makes it possible to test for cointegration among integrated variables, by comparing the $t-$value of $\hat{\beta}_1$ with the appropriate critical value in MacKinnon (1991), see Kremers et al. (1992) for a an exposition.

In the following we report results for all the four Nordic economies. The main objective of the section is to evaluate the empirical stability of the wage equations over the sample period. However, we also provide an explanation of the overall results, so as to make it possible for the reader to make an independent opinion of the plausibility of the equations. We first discuss the Norwegian wage equation. Since that model has several common features with the estimated equations for the other countries, the presentation of the results for Sweden, Denmark and Finland is considerably shorter.

5.1 Norway

The estimated counterpart to (9) is reported in (10) below. Wage growth is found to depend negatively on the lagged wage share, the level of open unemployment and the replacement ratio, in addition to the effect of changes in prices, productivity, hours and the use of labour market programmes. As explained above, the t-value of the coefficient for the lagged wage-share can be interpreted as a test of the hypothesis of non-stationarity or of no cointegration, and in (10) we denote it t_{ECM}. The exact interpretation of $t_{ECM} = -8.8$ depends on how one view the temporal properties of the levels variables in (10), i.e. the lagged wage-share, the rate of unemployment and the replacement ratio. If the levels variables are stationary, the conventional critical values for the t-statistic apply, and $t_{ECM} = -8.8$ is of course highly significant. However, conventional (Dickey-Fuller) tests for units root non-stationarity imply that it is difficult to reject a unit root in these series, so for practical purposes we may view them as integrated of order one, or $I(1)$ in a common notation. In this case, the null hypothesis is that the wage-share, the rate of unemployment and the replacement ratio are unrelated $I(1)$ variables. Using the critical values in

MacKinnon (1991, Table 1), $t_{ECM} = -8.8$ is significant (at the 1% level), and we reject the null in favour of viewing the three variables as cointegrated. As employer taxes are included in the wage share, it follows that in the long run an increase in employer taxes is fully reflected in a lower wage rate, with no effect on the wage costs.

Note that (10) does not contain a wedge-term. The reason for this is twofold: First, since we reject non-cointegration in a model that does not contain the wedge-term, that equation appears to be balanced without the wedge-term $(p - q - at + pt)_{t-1}$, and $\beta_2 = 0$ therefore appears to be an acceptable restriction. Second, granted that we find the wage-share $(wc - q - pr)_{t-1}$ to be stationary (or alternatively that it cointegrates empirically with the rate of unemployment), we can check whether (10) omits a relevant variable by testing the significance of $(p - q - at + pt)_{t-1}$— which yields $t(21) = 0.6$ which corroborates that the wedge can be dropped from the specification. In terms of the model in section 2 this implies that there is no wedge effect in wage formation ($b_1 = 0$). Below we will show that the no-wedge restriction goes through for the other three countries as well.

Another typical result for all the countries investigated here is that, although we start out by modelling *nominal* wage growth as in equation (9) above, the preferred models are *real-wage equations* of the type given in (10). Hence, dynamic price homogeneity was found to be a data acceptable property and is imposed in (10). A test of this restriction of *dynamic homogeneity* yields $F(1, 21) = 0.03$ which is insignificant.[3] A somewhat intriguing result is that there is no contemporaneous effect of consumer prices— it is Δp_{t-1} which enters the equation, not Δp_t. Johansen (1995) contains exactly the same lagged response to consumer price growth. Taken at face value, this result implies that workers wait one year before they are (partially) compensated for a rise in the costs of living index. One explanation of the absence of a contemporaneous cost-of living effects is that Δp_t contains inflation *surprises* that are not reflected in the wage-settlements. However, using expected inflation Δp_t^e instead of Δp_t, and estimating by instrumental variables yields almost identical results. An altogether more likely explanation is that "time-aggregation" hides the within year response of manufacturing wages to increased costs of living. This is substantiated by quarterly studies of manufacturing wages: Although there is no impact effect of consumer prices in e.g. Nymoen (1989a), there is a quite sharp response in the course of the following few quarters.[4]

Another empirically valid restriction applies to the growth rates of product prices and productivity. Their elasticities are restricted to be equal, hence wage-setters adjust to changes in value added, irrespective of whether the change originates in price or productivity movements. Following the tradition of the Scandinavian model of inflation, we might call $\Delta(q + pr)_t$ the *wage-scope* variable, Aukrust

[3] The test is performed by estimating (10) with OLS, after "unrestricting" the coefficients of Δp_t and Δq_t.

[4] Yet another approach to the issue of inflation-expectations is taken by Rødseth and Holden (1990) who construct an "institutional" expectations series based on the information that are available to the parties prior to and during the period of (central) bargaining.. Adding such a variable to equation (10) and estimating with OLS (after first de-restricting Δp_{t-1}) yields a coefficient for Δp_t^e equal to 0.17, with estimated t-value $t(21) = 1.6$. The coefficients of Δp_{t-1} and $\Delta(q + pr - p)_t$ are almost unaffected compared to (10).

(1977). The wage-scope variable actually appearing in (10) is a two year average $\Delta_2(q+pr)_t$, which can be interpreted as averaging of the annual growth rates in order to extract more permanent changes in value added per man hour.

$$
\begin{aligned}
(10) \quad \Delta(\widehat{wc_t - p_{t-1}}) \;=\; & \underset{(0.007)}{-0.0584} + \underset{(0.037)}{0.446}\ \{0.5\Delta_2(q+pr)_t - \Delta p)_{t-1}\} \\
& - \underset{(0.010)}{0.276}\ \Delta h_t \underset{(0.0023)}{-0.0286}\, u_t \\
& + \underset{(0.017)}{0.109}\ \Delta lmp_t - \underset{(0.025)}{0.2183}\,(wc_{t-1} - q_{t-1} - pr_{t-1}) \\
& + \underset{(0.013)}{0.075}\ rpr_{t-1} + \underset{(0.007)}{0.039}\ i67_t, - \underset{(0.005)}{0.054}\ IP_t
\end{aligned}
$$

Method: OLS $T = 31$ [1964 − 1994], $R^2 = 0.9792$, $\hat{\sigma} = 0.58\%$
$t_{ECM} = -8.8$ $Stab_{\sigma}(1) = 0.07$ [0.5] $Stab_{\beta,\sigma}(10) = 1.09$ [2.54]
$\chi^2_N(2) = 0.11$ $F_{AR}(1,22) = 2.03$ $F_{HET,x^2}(15,6) = 0.55$

The hours-variable (Δh_t) picks up the direct wage compensation in connection with the reductions in the length of the working day in 1964, 1968,1969,1976 and 1987, see Nymoen (1989b) The estimated coefficient of Δlmp_t indicates that the active use of programmes in order to reduce open unemployment actually reduces wage pressure. However, since there is no levels effect of programmes, this is strictly a short-run effect. According to the estimated equation, it is the rate of open unemployment (u_t) which is the fundamental labour-market tightness indicator, which reflects that the restriction $\beta_3 = \beta_4$ have been found to be data acceptable. Rødseth and Nymoen (1998) give a full treatment of this issue, both for Norway and for the other three countries.

A final feature of (10) is the inclusion of two dummy variables. IP_t is designed to capture the effects of the wage-freeze in 1979 and the wage-laws of 1988 and 1989. It is 1 in 1979 and 0.5 in 1980 (low wage drift through 1979), 1 in 1988 ("first wage-law") and 0.5 in 1989 ("second wage law"). Similar dummies for incomes policy have been found to be significant in earlier studies on both annual and quarterly data (see e.g. Johansen (1995)). $i67_t$ is a separate dummy which is 1 in 1967 and zero otherwise, due to a major reform of social security in Norway in that year.[5]

The other statistics reported with t_{ECM} below the equation are the F-forms of the test of 1. order residual autocorrelation, and of heteroscedasticity due to squares of the regressors and a Chi-square test of residual normality. Finally, we report two of Hansen's (1992) statistics of parameter non-constancy,: $Stab_{\sigma}(1)$ tests the stability of the residual standard error (σ) individually. $Stab_{\beta,\sigma}(10)$ tests the joint stability of σ and the set regression coefficients (β). The degrees of freedom are in parenthesis, and, since the distributions are non-standard, the 5% critical values are reported in square brackets. None of the tests are significant, which indicates that (10) is stable over the sample.

Figure 5 confirms the stability of equation (10). The six first graphs show the recursively estimated elasticities in (10), with ±2 estimated coefficient standard

[5] Rødseth and Nymoen (1998) shows that the wage raising effect of reforms in social security in 1967 and 1971 can be captured be the increase in the payroll-tax rate (Δpt_t). However, to achieve that, the inflation rate has to be corrected for the increase in VAT in 1970.

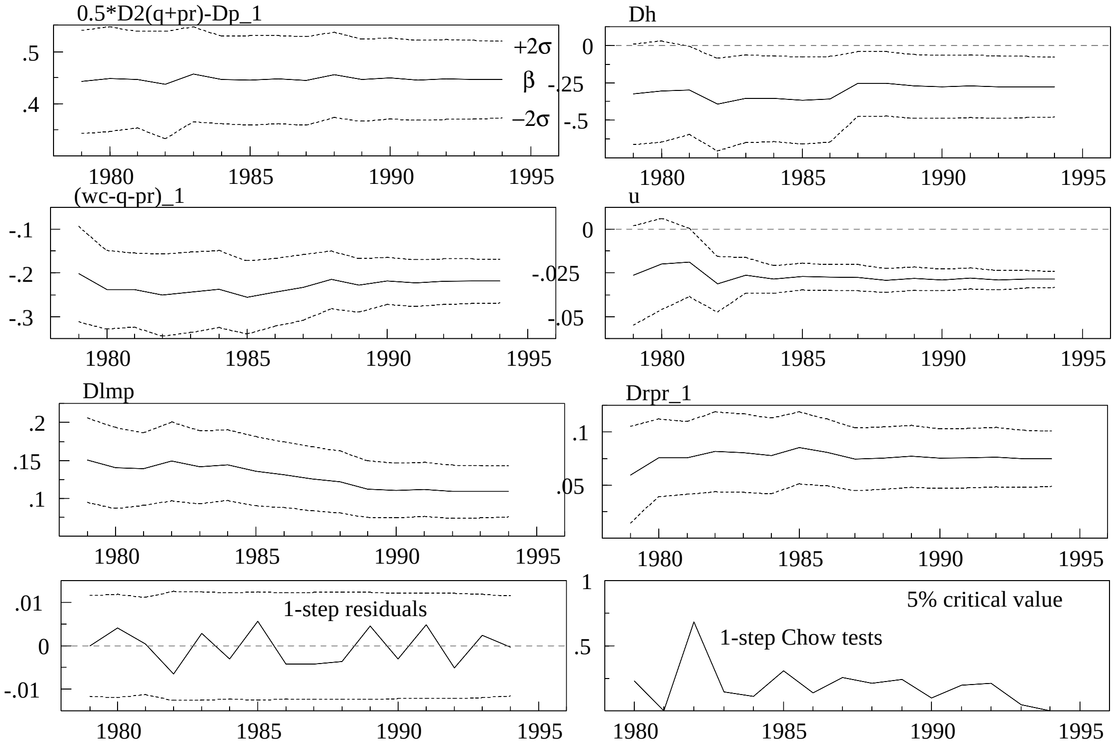

Figure 5: Norway: Stability of wage equation

errors, denoted β and $\pm 2\sigma$ in the graphs. The last two graphs show first the 1-step residuals with ± 2 residual standard errors as dotted bands, and finally the sequence of 1-step Chow statistics, scaled with their one-off 5% critical levels. All graphs show a high degree of stability, which is in contrast to the instability of the *NAWRU* estimate. If wage setting behaviour had changed, leading to increased structural unemployment, one would expect (10) to underpredict wage growth in recent years. This is not the case, as demonstrated by the lower left panel in figure 5.

In the light of the constancy of the empirical wage model in equation (10), the unstable *NAWRU* in figure 2 and 3 appears to be an artefact that does not provide valid evidence of increased "structural unemployment" in Norway. The only caveat is that (10) contains the replacement ratio *rpr*, that might be expected to shift equilibrium unemployment, this issue will be discussed in section 5.4 below.

5.2 Sweden, Finland and Denmark

Sweden

The Swedish wage equation, presented in (11), contains just two level variables, the rate of unemployment and the wage share (both lagged). As for Norway there is evidence of cointegration, in the form of the significance of $\mathrm{t}_{ECM} = -6.4$. Furthermore, when added to this model, the lagged wedge is insignificant ($t(24) = -0.81$), similar to what we found for Norway. However, unlike Norway, there is no effect

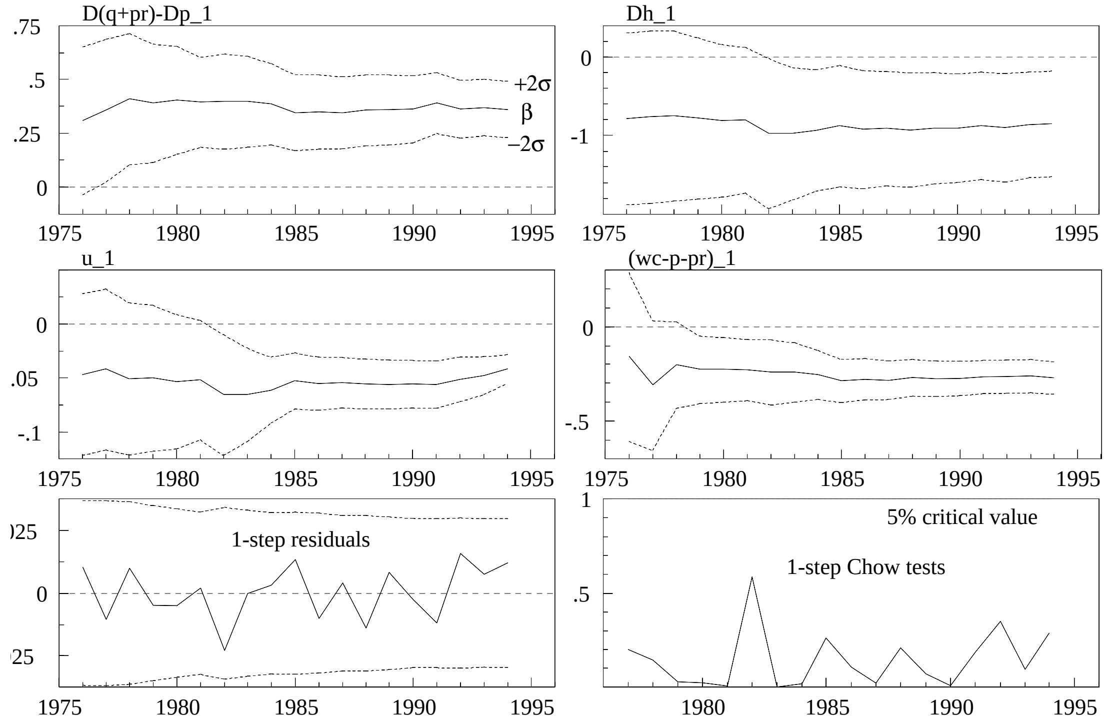

Figure 6: Sweden: Stability of wage equation

of the replacement ratio. Adding rpr_t and rpr_{t-1} to the equation in (11) yields $F(2,23) = 1.1$,with a $p-$value of 0.36, for the joint null hypothesis of both coefficients being equal to zero. Individually, current and lagged rpr are also insignificant; if we only keep rpr_{t-1} in the model, the estimated coefficient is 0.02 with a "t-value" of 0.9.

Turning to the short-run part of the equation, we note that again *dynamic homogeneity* is in terms of Δp_{t-1}, not Δp_t. In the same way as for Norway, this is not a result of OLS estimation as such: The instrumental variables estimate of the coefficient for Δp_t (when added to the equation) is zero, with p_{r-1}, wc_{t-1}, pr_{t-1} and p_{t-1} as instruments. Instead, time aggregation seems to be a more likely explanation, for example Forslund and Risager (1994) find strong impact effects of consumer prices in their estimation of wage equations on bi-annual data.

$$(11)\ \widehat{\Delta(w_t - p_{t-1})} = \underset{(0.028)}{-0.157} + \underset{(0.066)}{0.360}\ \{\Delta(q+pr)_t - \Delta p)_{t-1}\} - \underset{(0.338)}{0.849}\ \Delta h_{t-1}$$

$$- \underset{(0.007)}{0.042}\ u_{t-1} - \underset{(0.043)}{0.273}\ (wc_{t-1} - q_{t-1} - pr_{t-1})$$

$$\begin{array}{lll} \text{Method: OLS} & T = 30\ [1964-1994], & R^2 = 0.854, \quad \hat{\sigma} = 1.49\% \\ t_{ECM} = -6.4 & Stab_{\sigma}(1) = 0.182\ [0.5] & Stab_{\beta,\sigma}(6) = 0.708\ [1.7] \\ \chi^2_N(2) = 0.007 & F_{AR}(1,25) = 0.04 & F_{HET,x^2}(8,17) = 0.43 \end{array}$$

The labour market variable is open unemployment. This specification was chosen after first estimating the model with the total rate of unemployment, tu, and the programmes variable, lmp. In that equation, the estimated elasticity of lmp_{t-1} is negative, in accordance with the Calmfors-Forslund (1991) hypothesis, which states that "accommodation" of unemployment leads to wage pressure, Calmfors and Forslund (1991). However, the hypothesis that lmp_{t-1} and tu_{t-1} have equal coefficients is not rejected ($\chi^2(1) = 1.49$ [0.20]), and therefore we represent the wage-increasing effects of programmes parsimoniously by using only the open unemployment rate, see also Rødseth and Nymoen (1998). Note that the left hand side variable i (11) is the hourly wage, not wage costs. This implies that the impact of an increase in $pt = \ln(1+$ *tax-rate on employment*) on wage costs is estimated to be equal to one. Testing the significance of the restriction on Δpt_t yields $F(1, 24) = 0.30$ [0.60]. Hence the results imply full and immediate pass-through of increased payroll-taxes to wage costs.

The diagnostic tests show no sign of mis-specification, and the insignificance of $Stab_\sigma(1)$ and $Stab_{\sigma,\beta}(6)$ indicates that the equation is stable over the sample period. The stability is supported by the diagrams in figure 6. We also tested the impact of intervention dummies that have been designed to capture the potential effects of the following episodes of active incomes policy and exchange-rate regime changes, see Calmfors and Forslund (1991) and Forslund and Risager (1994).

- "Post devaluation dummy": 1983-85
- Incomes policy 1974-76 and 1985
- Devaluation/decentralized bargaining, 1983-90

None of the associated dummies were even close to statistical significance when added to equation (11).

Finland

The Finnish equation is displayed in (12). As for the other countries, the $t_{ECM} = -4.49$ implies rejection of non-cointegration. Dynamic price homogeneity is also consistent with data; according to our results, there is full pass-through of *consumer* price increases, and no short-run effect of producer prices or productivity, (i.e., the short- run effect of a "wage-scope" variable similar to that we use for the other countries is estimated to zero). This implies short-run rigidity of consumer real-wages in Finland, consistent with earlier findings of Calmfors and Nymoen (1990) and Nymoen (1992). Three other aspects of the model are also in accordance with the two mentioned studies: Firstly, the wedge-term can be omitted because it lacks statistical significance—it obtains a "t-value" of $t(27) = 0.72$, when added to equation (12). Secondly, the replacement ratio (rpr) is statistically significant. Thirdly, there is sharp estimated response to the change in the rate of unemployment (total instead of open unemployment) but a comparatively low levels-effect of unemployment, i.e. the estimated "wage-curve" is almost horizontal.[6]

[6]See Nymoen et al. (1998) figure 5.1 for an illustration of the difference in estimated real-wage responses in the Nordic countries.

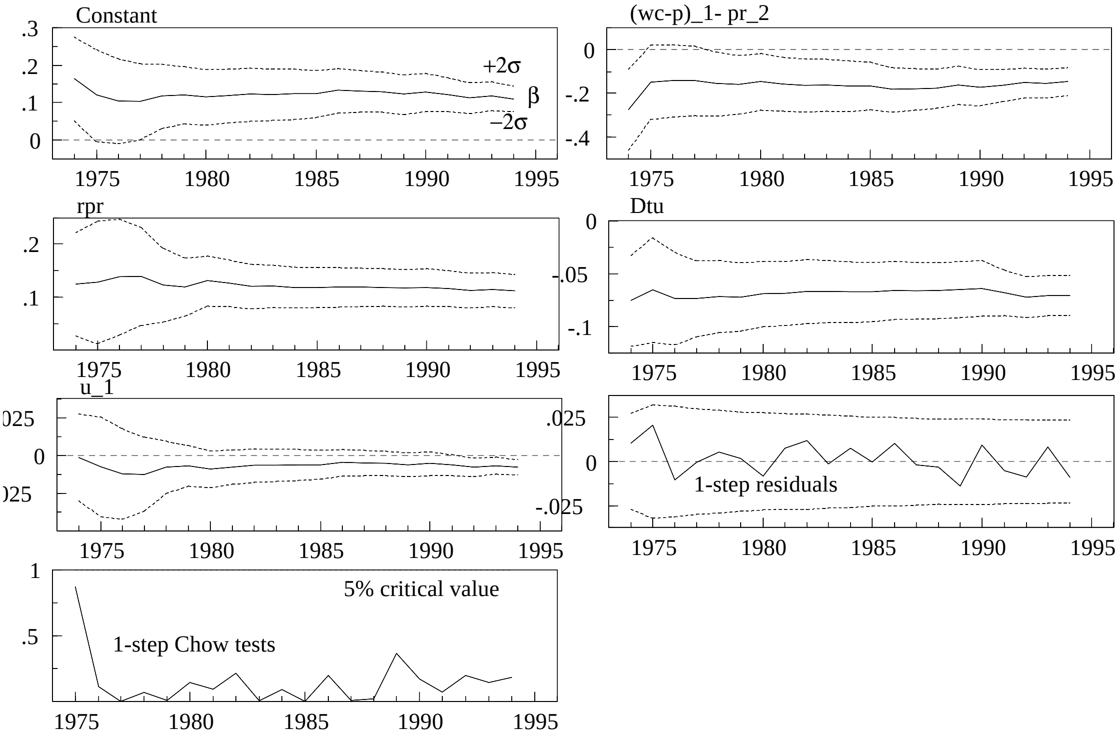

Figure 7: Finland: Stability of wage equation

$$\Delta(\widehat{wc-p})_t = \underset{(0.017)}{0.110} + \underset{(0.015)}{0.111}\, rpr_t - \underset{(0.009)}{0.070}\, \Delta tu_t - \underset{(0.003)}{0.007}\, u_{t-1} - \underset{(0.033)}{0.146}\, (wc_{t-1} - q_{t-2} - pr_{t-2}), \tag{12}$$

Method: OLS $T = 33$ $[1962-1994]$, $R^2 = 0.809$, $\hat{\sigma} = 1.17\%$
$t_{ECM} = -4.49$ $Stab_\sigma(1) = 0.242$ $[0.5]$ $Stab_{\beta,\sigma}(6) = 0.761$ $[1.7]$
$\chi^2_N(2) = 0.59$ $F_{AR}(1,27) = 1.03$ $F_{HET,x^2}(8,18) = 0.39$

The stability of the equation is indicated by the insignificance of the tests $Stab_\sigma(1)$ and $Stab_{\sigma,\beta}(6)$, and corroborated visually by figure 7.

Denmark

The Danish wage equation is shown in (13). As for the other countries, the $t_{ECM} = -3.89$ supports rejection of non-cointegration. Furthermore, dynamic homogeneity

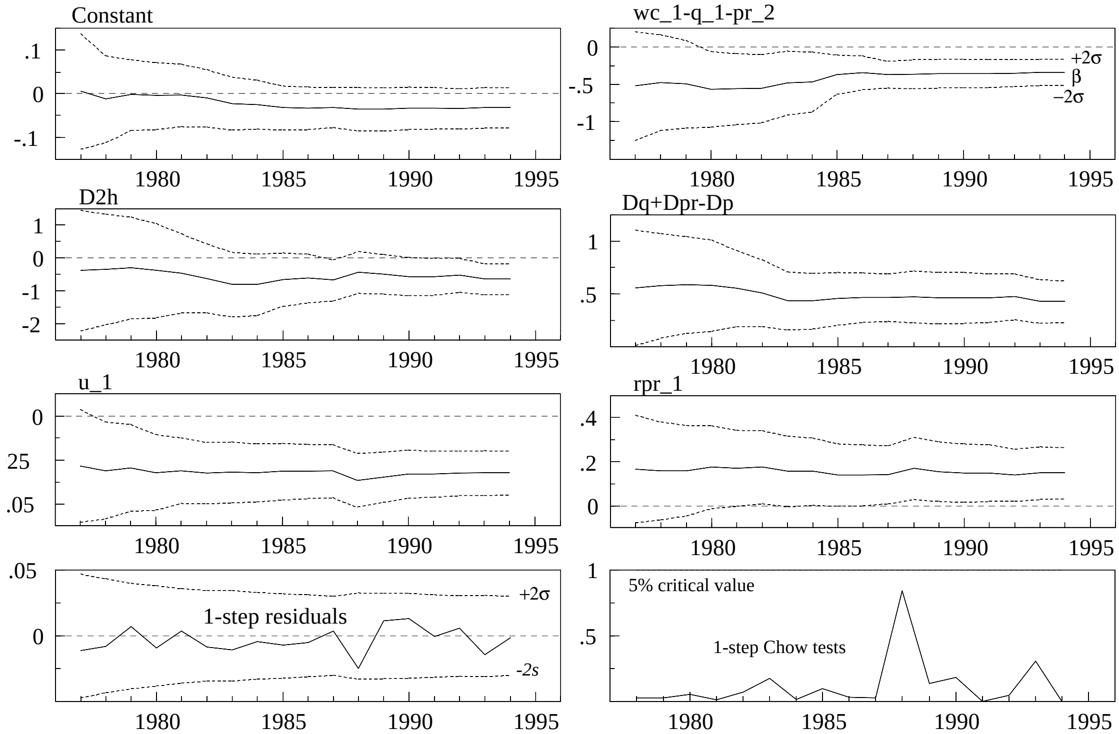

Figure 8: Denmark: Stability of wage equation

is supported by data.

$$\Delta(\widehat{wc-p})_t = \underset{(0.022)}{-0.032} - \underset{(0.230)}{0.642}\,\Delta_2 h_t + \underset{(0.097)}{0.430}\,\Delta(q+pr-p)_t \tag{13}$$
$$- \underset{(0.087)}{0.337}\,(wc_t - q_t - pr_{t-2}) - \underset{(0.006)}{0.0322}\,u_{t-1}$$
$$+ \underset{(0.057)}{0.150}\,rpr_{t-1},$$

Method: OLS	$T = 27$ [1968 − 1994],	$R^2 = 0.85$, $\hat{\sigma} = 1.51\%$
$t_{ECM} = -3.89$	$Stab_{\sigma}(1) = 0.29$ [0.5]	$Stab_{\beta,\sigma}(7) = 0.86$ [1.9]
$\chi^2_N(2) = 2.17$	$F_{AR}(1,20) = 3.58$	$F_{HET,x^2}(10,10) = 0.786$

Hence (13) is a *real-wage equation*, with growth in the consumer real wage $\Delta(wc - p)_t$ on the left hand side and only variables in real-terms among the explanatory variables: The coefficients of Δq_t and Δpr_t are restricted to be equal, meaning that wage setters are indifferent to whether higher value added is due to improved productivity or to increased output prices. Jointly with the dynamic homogeneity restriction, this yields a wage-scope variable $\Delta(q + pr - p)_t$ on the right hand side, which has its equivalence in the equations we have seen for Norway and Sweden. For working time, the appearance of a two year difference $\Delta_2 h_t$, rather than just Δh_t, reflects that pay compensation has been given the year after the actual reductions in the length of the working day.

In the same as for the three other countries there is no wedge in the equation, the lagged wedge obtains a "t-value of $t(17) = -0.83$ when added to the model[7], but we note that the lagged replacement ratio is included with a coefficient that is close to what we obtained for Finland and Norway.

The tests of the stability of the regression, $Stab_{\sigma}(1)$ and $Stab_{\sigma,\beta}(7)$, are insignificant. Furthermore, figure 8 provides graphical evidence of the stability of the wage equation right up to the end of the sample. None of the tests statistics for residual autocorrelation, non-normality and heteroscedastcity are significant at the 5% level.

5.3 Encompassing tests

As the NAWRU-indicator is not based on an estimated wage equation, the *NAWRU*-indicator cannot be included directly in a standard encompassing test. However, a key prediction of the *NAWRU*-method, that the variable to be explained really is the change in the money wage growth ("high" unemployment leads to a reduction in wage growth, while "low" unemployment leads to increasing wage growth) can investigated within an encompassing framework. Thus, we estimate the nested model, where lagged wage growth is included in our empirical wage equations, in addition to unrestricting dynamic homogeneity. The *NAWRU*-method would suggest that lagged wage growth obtains a unit coefficient, while other coefficients, except the coefficient for unemployment, are equal to zero. A Wald test for general restrictions yields an overwhelming rejection of the restrictions according to the *NAWRU*-method, with χ^2 test values from 80 and 550 (p-values less that 0.0000). In contrast, a Wald test for the restrictions imposed by our wage equations, a zero coefficient for lagged nominal wage growth and dynamic homogeneity, yields $\chi^2(2)$ test values from 0.36 to 2.93 (maximum p-value = 0.23, for Finland). The acceptance of the restrictions in our wage equations is also reflected in that lagged nominal wage growth, when included in our wage equations, obtains coefficients values that are close to zero ; -0.07 (0.44) for Denmark; 0.18 (0.10) for Finland; 0.07 (0.06) for Norway; 0.02 (0.14) for Sweden (standard errors in parenthesis).

The economic lesson that can be drawn from these encompassing tests is that the idea that high unemployment leads to a consistent reduction in nominal wage growth, while low unemployment leads to a consistent increase in wage growth, yields a bad description actual wage setting. This complements our finding in section 3 that the deviation of actual from structural unemployment (as measured by the *NAWRU*-indicator) explains nothing of actual changes in wage growth.

5.4 Interpreting our results

In the previous section, we documented the existence of stable empirical wage equations for the four Nordic countries. However, a stable wage equation does not prevent a shift in the wage curve in the employment- real wage space, if other explanatory variables have changed. For example, if the replacement ratio has risen, the wage

[7] Three years are lost at the start of the sample when the lagged wedge term is included, hence the degrees of freedom is 17 instead of 20.

curve in figure 1 would shift upwards, and so would the equilibrium rate of unemployment, in spite of a stable empirical wage equation where the replacement ratio was included. Regarding this particular variable, the replacement ratio, this hypothesis is not correct, as the replacement ratio has not risen over the last part of our sample period when the unemployment rate has risen; for Finland and Denmark, the replacement ratio is considerably lower at the end of the sample period (where unemployment is at or close to the top), than it was around 1970, for Norway the replacement ratio has varied around a stable level since the mid 1970s.

To detect possible shifts in the wage curve due to the combined effect of all the explanatory variables, it is necessary to distinguish between shifts in the wage curve and movements along the curve. As movement along the curve is associated with a change in the wage share, this can be done by controlling for the effect of the lagged wage share. If in one year the actual wage share were a unusually low, this would induce additional wage pressure (i.e. higher predicted real wage growth) in the following year. However, this would be movement along the wage curve, and not a shift in the wage curve. To capture the overall effect of the evolution of all the other explanatory variables, while at the same time controlling for the effect of the wage share, we construct a new variable, the Average Wage-Share rate of Unemployment *AWSU*. This variable is defined as the rate of unemployment that (according to our estimated wage equations) in each year would have resulted in a constant wage-share in that year, if the actual lagged wage share were equal to the sample mean.

To clarify the calculation and interpretation of *AWSU*, consider a "representative" estimated wage equation

$$\text{(14)} \qquad \begin{aligned}\Delta(wc_t - p_t) &= b_0 - b_1\overline{(wc - q - pr)} + b_2\Delta(q + pr - p)_t - b_3 u_t \\ &\quad + b_x^{'} X_t,\end{aligned}$$

where$\overline{(wc - q - pr)}$ is the sample mean of the wage share, and we recognize dynamic price homogeneity, a wage scope variable and $b_x^{'} X_t$ which contains other, country-specific effects. Solving for u_t with $\Delta(wc - q - pr)_t = 0$ imposed yields

$$\text{(15)} \qquad u_t = \frac{b_0}{b_3} - \frac{b_1}{b_3}\overline{(wc - q - pr)} + \frac{b_2 - 1}{b_3}\Delta(q - p + pr)_t + \frac{b_x^{'}}{b_3} X_t.$$

and the exponential of the left hand side of (15) is the *AWSU*. In the calculations of the *AWSU*, actual values are used for all the variables appearing in the estimated equations.

What would happen to the *AWSU* if the equilibrium rate of unemployment were to rise due to a rise in the explanatory variables in the wage equation? It would rise, because to keep the wage share constant when other variables induce higher wage growth, the rate of unemployment must also be higher to offset the effect of the other variables. The graphs of the *AWSU* are displayed in figure 9. A striking feature of the *AWSU*s are the large fluctuations, which are the result of fluctuations in the explanatory variables. In general, there appears to be little correlation between the *ASWU* and the actual rate of unemployment. At some occasions, a rise in wage pressure (as measured by *AWSU*) has immediately preceded a rise in unemployment. Sweden 1990 is the best example of this phenomenon, and the AWSU

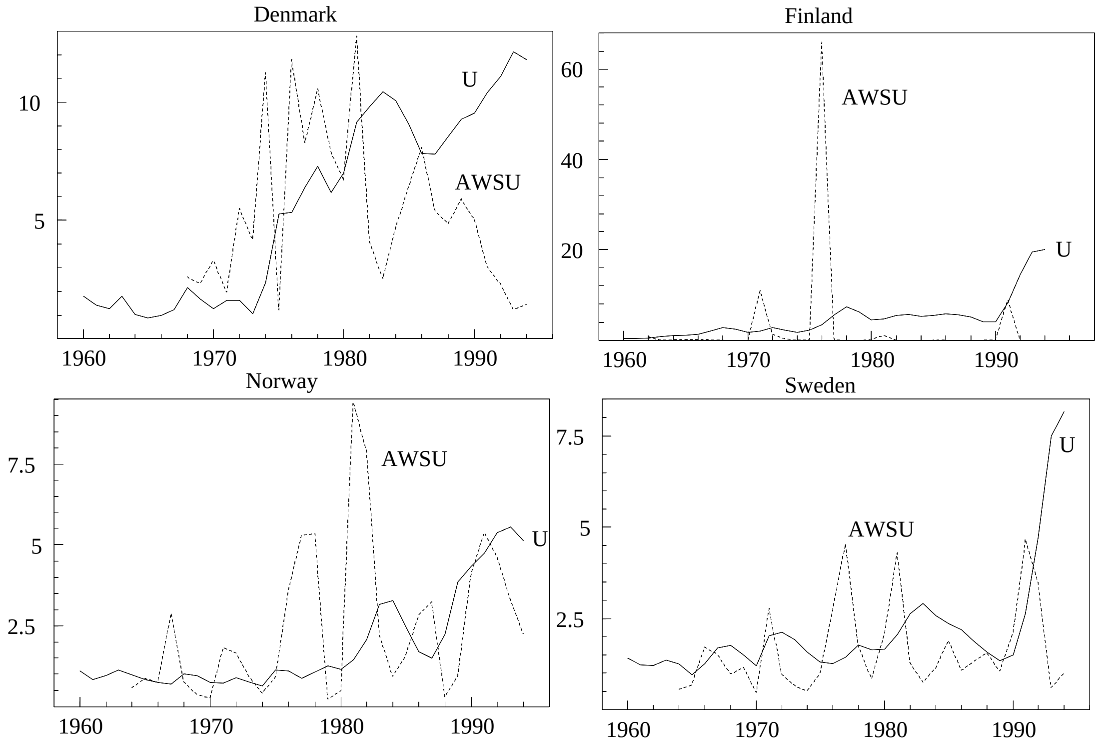

Figure 9: Unemployment and the Average Wage-Share rates of Unemployment (AWSU; see explanation in text).

might be an indicator of a rise in wage pressure, inducing an increased equilibrium rate of unemployment at that point in history. The unemployment rates in the following years seem however to be much higher than any reasonable equilibrium rate, an interpretation that is in line with the findings in Forslund (1995). For Denmark and Norway, the $AWSU$ and the actual rate of unemployment have changed in the opposite direction since mid 1970s (Denmark) and early 1980s (Norway). Furthermore, wage pressure as measured by the $AWSU$ falls markedly in the 1990s, while unemployment rose in all countries from 1990 to 1994. For Finland, the $AWSU$ is difficult to interpret due to large fluctuations (which numerically is a consequence of the small estimated elasticity of unemployment in the wage equation), but in any case no upward trend can be detected. The overall conclusion is that there is little correlation between wage pressure (as measured by the $AWSU$) and unemployment; in particular the recent rise in unemployment cannot be explained by a rise in wage pressure.

As a shift in the wage curve involves a rise in the $AWSU$, the absence of a rising trend in the $AWSU$ over the last decade is evidence against the view that the rising unemployment is the consequence of outsider hysteresis. While some sort of outsider hysteresis clearly can have taken place without inducing a detectable rise in the $AWSU$, more extensive outsider hysteresis effects would, as pointed out in section 2, lead to a considerable shift in the wage curve, and thus also a rising $AWSU$.

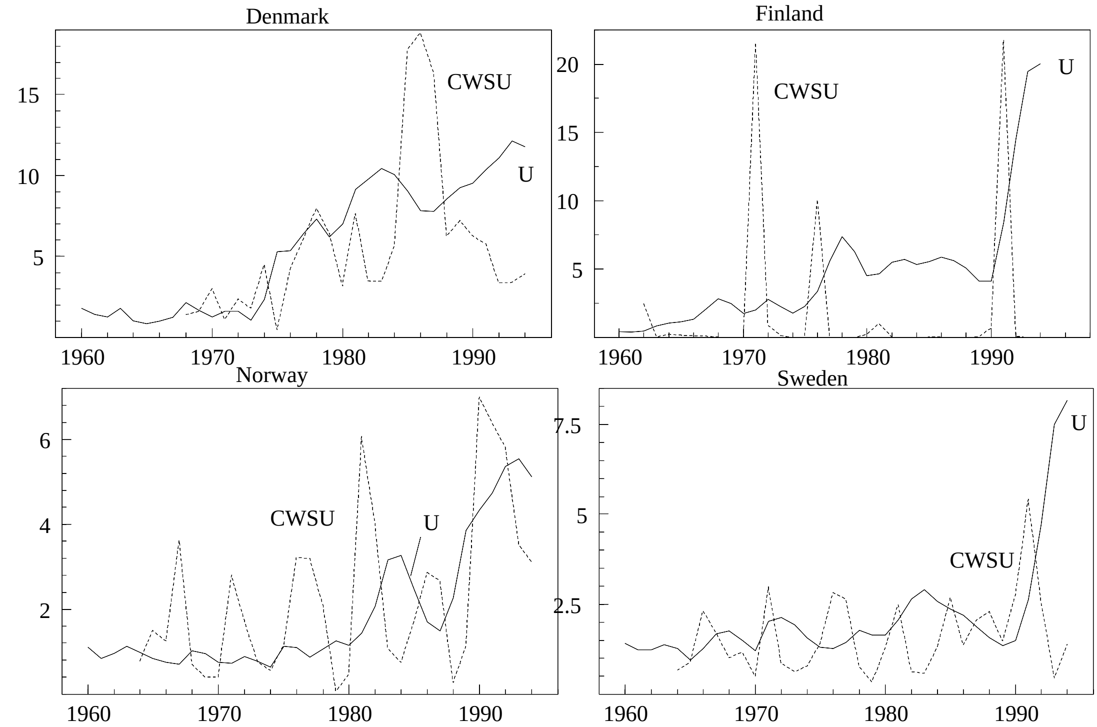

Figure 10: Constant wage-share rates of unemployment (CWSUs) for Denmark, Finland, Norway and Sweden.

While the $AWSU$ is constructed to detect shifts in the wage curve, thus controlling for movement along the wage curve, it may also be of interest to obtain an indicator of wage pressure where the effect of the lagged wage share is included. Thus, we define the Constant Wage Share rate of Unemployment, $CWSU$, as the rate of unemployment that in each year would have resulted in a constant wage share. It is constructed just as the $AWSU$, using equations (14) and (15), except that the sample-mean wage share is replaced by the actual values of the lagged wage share. The $CWSU$ is thus a rough indicator of the overall wage pressure in a given year. Compared to the $AWSU$, the $CWSU$ suggests (cf. figure 10) lower wage pressure in the late 1970s/early 1980s (when the high wage share had a dampening effect on wage pressure), and higher wage pressure in the mid 1980s (Denmark) and 1990s (Norway). We emphasize, however, that a rise in the $CWSU$ cannot be taken as an indication of a rise in the equilibrium rate of unemployment due to a change in the wage setting behaviour, as it also reflects movements along the wage curve in the employment-real wage space (due to a reduction in the wage share).

6 Summary and conclusion

In recent years, the OECD has measured the structural (or equilibrium) rate of unemployment by use of a specific method, the $NAWRU$-indicator. Crudely, the $NAWRU$-indicator measures the structural rate of unemployment as the rate of unemployment at which money wage growth is constant. In practice, this implies that a reduction in money wage growth is taken to imply that the structural rate of unemployment is below the actual rate of unemployment, and vice versa. In the Nordic countries, as well as in most other European countries, the *NAWRU*-indicator has risen in line with the rise in actual unemployment. Thus, the *NAWRU*-indicator has contributed to the view that the bulk of unemployment is structural. Furthermore, the *NAWRU*-indicator is also used as an important part in the calculation of output gaps and the structural budget balances by the OECD. The OECD figures for the output gap and the structural budget balance are important elements in policy discussions by the OECD, as well as by national governments and independent policy observers.

The *NAWRU*-indicator is, however, constructed by a very simplistic method, with limited use of information. In view of the large importance given to the indicator, it seems worthwhile to investigate whether the results are robust to a more thorough analysis. Thus, we analyze the evolution of wages in the manufacturing sector in each of the Nordic countries to see whether our results are consistent with the evolution of the *NAWRU*-indicator. Due to the increase in the *NAWRU*-indicator, as well as the fact that many of possible explanations for the rising unemployment are related to the wage setting (cf. Bean (1994)), we would expect to find a change in wage setting behaviour that corresponds to the rise in unemployment. However, we find no changes in wage setting behaviour for any of the Nordic countries, nor do we detect changes in explanatory variables in the wage setting that can explain the rise in unemployment. The instability of the *NAWRU*-indicator appears to be an artefact of a mis-specified wage equation, and not due to instability in the wage setting itself.

A possible objection to our conclusions is that the *NAWRU*-indicator is a short run concept, aimed at measuring the rate of unemployment at which money wage growth is stable. On this view, it could be argued that one cannot expect this short run concept to coincide with the long run equilibrium rate of unemployment, but it may nevertheless be of some interest. One problem with this argument is that the *NAWRU*-indicator is not a good measure even of the rate of unemployment at which money wage growth is stable. This is evident from its poor predictive power; as shown in section 3, the *NAWRU*-indicator has virtually no explanatory power even within sample. The reason is that the *NAWRU*-indicator is based on a too restrictive view of actual wage setting. Whether money wage growth increases depends on a host of other explanatory variables than the rate of unemployment. For example, if inflation expectations have gone down, money wage growth may also be reduced even if unemployment is low. Or if the wage share is low, money wage growth may increase even if unemployment is high.

As mentioned in the Introduction, our findings have broader implications than those connected to the *NAWRU*-indicator. Most explanations given in the literature for a rise in structural unemployment would result in increased wage pressure. In OECD Economic Surveys for Sweden, 1996-97, page 81, the increase in the *NAWRU*-indicator is viewed as evidence that unemployment in Sweden exhibits strong persistence, and two particular mechanisms are mentioned: ".. the influence of the unemployed on the wage bargaining process tends to diminish the longer they remain unemployed, either because of a reduction in their human capital or because they become "outsiders" to the wage-setting process." As shown in section 2, such outsider effects would lead to a shift in the wage curve, and is in contrast to our finding that there has been no such shift, cf. the absence of a rising trend in our estimated indicator for wage pressure, the $AWSU$ (cf. discussion in section 4.4). As shown in the appendix, even a change in relative demand for labour, from unskilled to skilled, as suggested by Juhn et al. (1991) and others, would result in a shift in the wage curve, in contrast to our findings.

On the other hand, our wage equations are not inconsistent with hysteresis at a more general level, i.e. the fact that unemployment series are heavily autocorrelated and also show signs of deterministic shifts in mean. But an elucidation of these interesting features requires joint modelling of wage-setting and labour supply and demand, an issue that is outside the scope of our study.

The reader might wonder, how can our conclusion be correct, in view of the overwhelming evidence that unemployment has risen due to the increase in labour market regulations and distortions. In fact, the evidence regarding a link between labour market regulation and unemployment is not overwhelming. There is undoubtedly strong evidence that some labour market features, like high and long-lasting unemployment benefits, do contribute to high unemployment. This is reflected in our own study, as we find a significant wage-raising effect of the replacement ratio for Denmark, Finland and Norway. On the other hand, it is not at all clear how important these features are in explaining the large increase in unemployment that has taken place. In a review of studies based on times series, Gregg and Manning (1996) argue that " .. these models are unable to explain the rise in unemployment in terms of increased labour market regulation.." because " .. from the early 1980s, the labour market policies adopted in most countries have ended to favour de-regulation; yet unemployment has continued to rise." Likewise, Nickell (1997) concludes a study of OECD unemployment by the statement that "the broad-brush analysis that says that European unemployment is high because European labour markets are "rigid" is too vague, and probably misleading."

Our study raises at least two crucial questions. First, if one accepts our conclusion that the wage setting in the Nordic countries has not changed, why does the high unemployment persist (at least in Finland and Sweden)? Secondly, why doesn't the high unemployment lead to continuous reduction in wage growth? Our empirical investigation answers the second question. The idea that wage growth increases or decreases depending on whether unemployment is high or low, yields a bad description of real world wage setting. A high level of unemployment does have a dampening effect on wage growth (except for Finland). However, if the lower wage growth reduces the wage share, this counteracts the dampening effect of high unemployment.

The first question is more complex. Based on the theoretical framework laid out in section 2, a rise in actual unemployment combined with a stable wage curve can be given two alternative interpretations: (i) actual unemployment has risen, while equilibrium (structural) unemployment has remained constant; (ii) equilibrium unemployment has risen due to a shift in the price curve. Interpretation (i) could be supported by the fact that in the Nordic countries (as in much of the rest of Europe) aggregate demand has been weak over longish periods during the last 5-15 years (first in Denmark, later in Norway, Finland and Sweden). Furthermore, the self-correcting mechanisms of the economy are probably weak, so that it may take long time before an economy reverts back to the long run equilibrium (Holden (1997)).

Interpretation (ii), that the price setting has changed, could perhaps be explained by the higher level of real interest rates internationally after 1980. A rise in the real interest rate induces a reduction in the use of capital, thus reducing demand for labour and shifting the price curve inwards, resulting in an increase in equilibrium unemployment. A shift in the price curve is also consistent with the reduction in wage shares that has taken place in most European countries, including the Nordic, over the last 15 years.[8]

As yet, these alternative explanations are little more than speculative thoughts. However, the results of our study strongly suggest that one should broaden the view, and also look for explanations of high unemployment that do not focus solely on a malfunctioning labour market.

A Mismatch

In this appendix, we show that a shift in the relative demand for labour, leading to increased mismatch, also results in a shift in the aggregate wage equation, even if the wage equation of each type of labour is constant. The aim is to show that a shift in demand from unskilled to skilled labour would lead to an outward shift in the aggregate wage equation. To keep the analysis simple, we use a highly stylized model with two groups of labour, 1 and 2. Labour supply of each group is given exogenously, L_1 and L_2, and $L_1 + L_2 = L$. Wages are given by identical wage curves for each group

$$w_i = v_0 - v_1 u_i, \qquad v_0, v_1 > 0, i = 1, 2.$$

where $U_i = (L_i - N_i)/L_i$ is the rate of unemployment for each group, and $u_i = \log(U_i)$. The crucial assumption is that the wage curve for each group is convex, cf. Layard et al. (1991), page 308. The rate of unemployment is lower for group 1, $U_1 < U_2$. The aggregate wage level is thus

$$w = (L_1/L\,)w_1 + ((L - L_1)/L)w_2 = v_0 - v_1((L_1/L)u_1 + ((L - L_1)/L)u_2).$$

Now assume that there is a shift in relative demand for labour, so that the employment of group 1 increases marginally by $dN_1 > 0$, while the employment of group 2 decreases by the same amount, $dN_2 = -dN_1 < 0$. Aggregate employment is constant, and so is aggregate unemployment. However, aggregate wages increase, as can be seen from

$$dw = -v_1[(L_1/L)(1/U_1)(-1/L_1)dN_1 + ((L - L_1)/L)(1/U_2)(-1/(L - L_1))dN_2]$$

(as $d\log((L_i - N_i)/L_i)/dN_i = (1/U_i)/(1/L_i)$). This can be simplified to

$$dw = -(v_1/L)[(1/U_1) - (1/U_2)]dN_1 > 0,$$

[8] Obviously, one can view this explanation from a different angle, attributing the rise in unemployment to wage setting not being able to accommodate the shift in the price setting.

as $U_1 < U_2$. Thus, a shift in relative demand for labour, from a group with high unemployment favouring a group with low unemployment, leads to higher wages for a given level of unemployment. In other words, the aggregate wage curve shifts, in spite of constant wage curves for the each group.

B Data

All data are taken from the database on Nordic wage formation documented by Evjen and Langset (1997) and is the same data set that is used in the paper on Nordic wage formation by Rødseth and Nymoen (1998). The data is available in spreadsheet or PcGive format, and can be downloaded from the following URL: http : //www.uio.no/˜rnymoen. Below we first give a general definition of each variable used in the empirical sections of this paper. In brackets, we give the variables' names in Evjen and Langset's database, and the algebra we have used to transform each variable into the form it is used in the estimated equations.

- wc = log of wage casts per hour in manufacturing. [Source variable : WC, 1970 = 100] : Transformation: $wc = \ln(WC/100)$.]
- p = log of the consumer price index [Source variable: CPI, 1970 = 100, Transformation: $p = \ln(CPI/100)$].
- q = log value added deflator for manufacturing [Source variable: P, 1970 = 1. Transformation: $q = \ln(P/100)$].
- pr =log of average labour productivity in manufacturing [Source variable: PR, 1970 = 100. Transformation: $pr = \ln(PR/100)$].
- pt = log of one plus the pay roll tax [Source variable: PT. Transformation: $pt = \ln(1 + PT)$].
- at = log of one minus the income tax rate [Source variable: AT. Transformation: $at = \ln(1 - AT)$].
- we = wedge ($we = pt - at + p - q$).
- h = log of normal weekly working hours. [Source variable: Denmark: H, Finland H, Norway: HR, Sweden: HR. Transformation: $h = \ln(H)$ and $hr = \ln(HR)$].
- rpr = log of replacement rate [Source variable: RPR. Transformation:$rpr = \ln(RPR)$].
- u = log of open unemployment (registered unemployed) in per cent of labour force [Source variable: U. Transformation: $u = \ln(U)$].
- tu = log of total unemployment (registered unemployed plus participants in active labour market programmes) in per cent of labour force [Source variable: $TUPR$. Transformation: $tu = \ln(TUPR)$].
- lmp = log of one minus the per cent of total unemployed who are participating in active labour market programmes. Yearly average.[Source: $AMUN$. Transformation: $lmp = \ln(1 - AMUN/100)$].
- IP = Dummy for income policy in Norway. 1 in 1979. 0.5 in 1980. 1 in 1988 and 0.5 in 1989.

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