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LABOUR MARKET FLEXIBILITY IN NORTHERN EUROPE

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Abstract

With the restraints on both monetary and fiscal policy in Stage 3 of Economic and Monetary Union great pressure is put on structural policies and the operation of the labour market in particular to limit the adverse impact of asymmetric shocks and economic fluctuations. This paper contrasts the position of Finland, which is the only part of Northern Europe in the euro area with other parts of the region and similar regions. Drawing on earlier work on the flexibility of the Finnish economy (Vilmunen and Mayes, 1998) this paper explores whether the form of centralised bargaining practised in the region offers an adequate ability to respond to the prospective shocks.

1 Introduction

The onset of the euro area offers a new challenge on the member states to be able to adjust to economic shocks. The traditional monetary, fiscal and regulatory instruments of economic policy are now constrained, moving their position towards that of regional administrations in a wider state. Yet at the same time there has been no move towards the inter-regional fiscal transfers that characterise most federal systems. If the costs of such shocks, particularly in terms of unemployment, are not to increase the member states must either find new adjustment mechanisms or improve the effectiveness of those that already exist. One of the main recipes that has been put forward is increased 'labour market flexibility' (see Council of State, 1997, for example). Thus if the impact on the labour market cannot be reduced so much by other policies the labour market itself must adjust rather better.

There has been a presumption in many quarters (OECD, 1994) that this flexibility would come from substantial deregulation of the labour market and a move towards decentralised bargaining, perhaps along the lines of New Zealand (Mayes and Silverstone, 1998; Chapple, Harris and Silverstone, 1995). However, it is arguable (Council of State, 1997; Teulings and Hartog, 1998) that this flexibility could also come through the ability of centralised bargaining to negotiate economy-wide, enforceable agreements. Such agreements could alter real wages and conditions right across the labour market in order to limit the impact of shocks on employment in a manner perceived as fair. This would be an illustration of the Calmfors and Driffill (1988) argument that it is the extremes of centralisation and decentralisation in wage bargaining that are most likely to deliver efficient outcomes. Centralisation can offer an opportunity for co-operation, while decentralisation can limit bargaining power for adverse outcomes.

It is, however, notable that this expectation, that centralised wage bargaining inter alia might offer a satisfactory way forward under EMU, is not necessarily shared in practice. For example, of the five Nordic countries, Iceland and Norway have chosen not to participate in the EU, Denmark and Sweden have chosen not to participate in the euro area and only Finland is a full participant in Stage 3 of Economic and Monetary Union. There are of course many other reasons for non-participation but the Swedish case illustrates the concern over labour market flexibility. In its assessment of the impact of membership of Stage 3 on Sweden, the Government Commission on the EMU (Calmfors, 1997) places the problem of reducing unemployment first among the arguments that lead it to conclude that Sweden should not be in the first wave of countries joining.

> 'There is a significant risk in participating in the monetary union with the current high level of unemployment. It would be very serious if Sweden were exposed to new macroeconomic disturbances that could not be counteracted by monetary and exchange rate policies. This could lead to *further* increases in unemployment from today's high level. To a large degree, this valuation is based on macroeconomic experiences of the last decade in Sweden and other EU countries, which have shown how easily an upturn in unemployment can become permanent.'

Our main concern in this paper is to examine the case of Finland, as it will face the problem of adjustment under EMU first among the Nordic countries.[1] We consider first of all the degree to which the centralised bargaining regime in Finland seems to have an ability to adjust to shocks over the period 1960 to 1996. We compare this to a more decentralised regime, like that of New Zealand. Secondly, by using cross section data for the whole of the OECD over the period 1973 to 1996, we explore the interaction between labour market institutions and central bank structures in affecting inflation and unemployment. We use these results to consider two further issues. First, the extent to which the Calmfors and Driffill hypothesis - that it is the two extremes of centralisation and decentralisation of wage-bargaining that show the least unemployment costs from shocks - is borne out. Second, the impact that the change from monetary policy being run by the Bank of Finland to being run by the ECB is likely to have on unemployment.

In general terms, our conclusions are that the exchange rate did not form an important part of the adjustment mechanism of unemployment in Finland until recently after the collapse of trade with the former Soviet Union (Mayes *et al*, 1999, ch.2). So membership of EMU is not likely to impose substantial extra constraints, if there are no internally generated unsustainable increases in real wages. However, by the same token Finland has not shown flexible responses to adverse shocks – in the sense of reducing real wages -, so the structure of behaviour will need to be different in the absence of favourable shocks if unemployment is to continue to fall rapidly. Typically, downward adjustments of the nominal exchange rate were used to help offset excess increases in Labour costs. EMU, however, appears to be acting as just such a favourable shock and the change in the central bank structure to the ECB will tend to assist the further fall in unemployment. Furthermore, we find some support for the hypothesis that Finland will be advantaged compared to some of the other euro countries in its response to shocks through the structure of its wage bargaining regime. However, the move to membership of EMU and the EU in the space of a decade, following the major shock at the beginning of the 1990s represents a major regime change. It would be surprising if there were no adaptation in behaviour as a result. Indeed there are signs that recent wage increases have been lower than previous behaviour might have implied.

2 Contrasting results – Finland compared

In order to investigate the extent of labour market flexibility we explore behaviour over the period 1960 to 1996. Following Mayes and Vilmunen (1998) we develop a small model of the labour market in an open economy, based on Jacobson *et al*. (1996). The choice of model is relatively pragmatic. The system covers the key features of the labour market in an open economy, yet is small enough to obtain reasonably determined estimates and understandable properties. The estimated model is a four-equation system that jointly determines unemployment, real wages, the capital stock and the terms of trade. It is based on firms' profit maximising behaviour from a Cobb-Douglas production function, labour supply under constrained utility maximisation by workers and the terms of trade balancing aggregate demand and supply. The economy is subject to shocks from technology, the rest of the world, wage setting and the supply of labour. Ideally one might want to in-

clude fiscal and monetary policy as well (Nadal De Simone *et al,* 1996; Dennis, 1996) but such models pose their own difficulties. An alternative would be to use larger macro-models such as Hukkinen and Viren (1998) or the Bank of Finland model BOF5 (Willman *et al,* 1998).[2]

We begin by assuming that production possibilities can be described by the (log of the) Cobb-

$$y_t = b\ k_t + a\ l_t + m_t \qquad (1)$$

Douglas functional form

where *y*, *k* and *l* denote, respectively, output, capital and labour, and is a stochastic shock to technology or production possibilities (i.e. a productivity shock), whose generating process may contain a unit root. From this we can derive the capital and labour required. Employment is given by

$$l_t = g_0 + g_1 k_t - g_2 n_t + z_t \qquad (2)$$

where = ln(*W/P*) is the real product wage, *W* the nominal wage, *P* the output price and an employment shock. If the firm is maximising profits, then $_1$ = $_2$ and $_2$ = 1/(1-) and = $_2$. Capital is determined by

$$k_t = r_0 + r_1 l_t - r_2 r_t + z_t \qquad (3)$$

where *r* is the (log of the) rental price of capital, *R*, or, simply, the real interest rate. In what follows we have simplified the model treating the real interest rate as constant[3] and hence subsumed by the constant $_0$. Note that employment and capital stock share the same shock , derived from the underlying shocks to technology, . For this reason will be simply referred to as a technolog i-cal shock . Under profit max imisation $_1$ = /(1-).

Labour supply is given by

$$l_t^s = q\ w_t + x_t \qquad (4)$$

where *w* = ln(*W*/) is the consumption real wage and is the consumer price index with the share of domestic consumer goods in the index denoted by [4]. Non-modelled factors affecting labour supply decisions by households[5] are represented by the stochastic shift variable , which is ge n-erated by a process that potentially contains a unit root.

We assume that the wage setting relation is

$$w_t = -s_1 u_t + s_2 q_t + w_{w,t} \qquad (5)$$

where *u* and *q* denote, respectively, the log of unemployment *U* and the terms of trade *Q*[6]. This particular form of the wage setting equation differs slightly from the standard one in the literature (e.g. Jacobson *et al*. eq. (4) p. 4) where the real *product* wage is expressed in terms of unemployment and productivity. Equation (5) uses the real *consumption* wage, as the difference between real product and real consumption wage in an open economy is related to the terms of trade. For a Cobb-Douglas type consumer price index - *w* = - (1-) *q*. Since labour supply decisions depend on the consumption real wage and labour demand decisions on the real product wage, changes in the terms of trade will affect the state of the labour market[7]. The terms of trade are an important potential source of aggregate fluctuations affecting small open economies. The non-modelled factors affecting wage formation, i.e. shocks to wage formation, $_{w,t}$, are also assumed to be generated by a process that potentially contains a unit root[8].

Finally, fluctuations in the terms of trade are assumed to evolve according to

$$q_t = -d_1 k_t - d_2 l_t + w_{q,t} \qquad (6)$$

where $_i > 0$. Equation (6) can be derived by combining an IS-schedule linking competitiveness to aggregate demand (at the constant real interest rate)[9] with an aggregate supply behaviour implied by (1) - (3), i.e. the terms of trade balances aggregate demand and supply. Under this interpretation, the terms of trade shocks $_q$ is a combination of aggregate demand and supply shocks (or shocks to the production technology). Thus it is possible that $_q$ is generated by a process containing a unit root. An alternative interpretation relies on mark-up pricing under exogenous terms of trade shocks.

Hence, all the shocks in the model can be represented by a simple random walk without loss of generality w.r.t. the long-run properties of the model

$$F_t = y\ F_{t-1} + e_{F,t} \qquad (7)$$

where $F = (, _w, , _q)$ is the underlying vector of shocks and $0 < \leq 1$[10]. It is thus possible to transform the model into a standard Vector Error Correction format. Without solving the model explicitly (see Jacobson *et al*. 1996), we know that the vector of the four endogenous variables of interest, $X = (u, w, q, k)$ can be solved [11] as a linear function of the underlying vector of shocks

$$X_t = A F_t \qquad (8)$$

where *A* is (4 x 4)-matrix summarising the impact effects of the shocks[12]. From (2) and (4) we can obtain an expression for (the rate of) unemployment[13] (the constant has been ignored)

$$u_t = l_t^s - l_t = (\theta + \gamma_2) w_t - \gamma_2(1-\phi) q_t - \gamma_1 k_t + \chi_t - \zeta_t . \qquad (9)$$

The demand for capital function (3) can be written as (once again ignoring the constant)

$$\begin{aligned} k_t &= -\rho_1 [l_t^s - l_t] + \rho_1 l_t^s + \zeta_t \\ &= -\rho_1 u_t + \rho_1 \theta w_t + \zeta_t + \rho_1 \chi_t \end{aligned} \qquad (10)$$

which is helpful when interpreting possible cointegration relationships.

2.1 Results for Finland

Semi-annual data for Finland are used covering the sample period 1960.1 - 1996.2.[14] The variables included in the empirical analysis are the logarithm of the rate of aggregate unemployment (*u*), real consumption wage (the ratio of average earnings to the CPI, 1990 = 100, *w*), terms of trade (ratio of export prices to import prices, 1990 = 100, *q*) and net capital stock in the business sector (*k*). We approach the estimation of this four equation in the standard VECM format using Johansen's (1995) procedure. The first step is to ensure that there are unit roots in each of the equations so that they are conformably integrated before moving on to determine the cointegrating relationships among the four variables.

Appendix I contains summary tables of the tests for unit roots. In conducting the tests, lags up to 4 (i.e. two years) were included, which appeared to be sufficient to filter out most of the autocorrelation remaining in the residuals after fitting an AR-process to the time series. Table I.1 summarises the results of the Augmented Dickey-Fuller tests.

Even though the formal test suggests a unit root in the (log) level of the variables in the system, the unemployment rate as well as the capital stock appear borderline cases, but in different directions. Whereas the log of the unemployment rate comes close to being stationary, the log of the capital stock appears to come very close to being an I(2) process! In particular the null of a unit root in the DGP for the rate of unemployment cannot be rejected when more lags are included in the ADF test. This may be a reflection of the reduction of power in unit root testing when the number of lags is increased[15]. On the other hand, the sum of the estimated AR-coefficients, in the case of the log of the capital stock, appears to be large in comparison to the corresponding ones of other variables

in the system, and even exceeding one, once lags are added. Further evidence is provided by table I.2, which tests for a unit root in the first difference of the series (i.e. growth rates)[16].

At face value, Table I.2 seems to suggest that there is also a unit root in the growth rate of real wages and the capital stock. However, the -coefficient on the relevant lagged difference for the growth rate of real wages is 0.48 and 0.42 at lags 3 and 4 respectively and the ADF-test suggests a unit root in the process generating growth in real wages. For the capital stock, on the other hand, the -coefficients are higher, but still well bounded above by 0.9. This suggests that there is a substantial amount of autocorrelation in the growth rate of the capital stock or that the growth rate of the capital stock series is relatively 'smooth'[17].

Further specification tests[18] suggest the following observations; (i) general as well as ARCH-type heteroscedasticity is present in the residuals from the ADF-test equation, which cannot be removed by the usual procedure of adding in further lagged differences. (ii) graphical inspection indicates that there are two large residuals around the year 1990, which give rise to deviations from normality in the form of thick tails and skewness to the left. These deviations from the ideal conditions underlying the ADF-tests tend to reduce the efficiency of these tests in finite samples[19]. Overall, then, the decision to reject the hypothesis of unit root nonstationary growth rates of the variables in our system should be viewed with caution, especially because of the test results for the growth rate of the capital stock. With this in mind, we will continue to the cointegration analysis under the assumption that the vector time series $X_t = (u_t, w_t, q_t, k_t)$ is generated by an I(1) vector process.

Johansen's procedure was followed to test formally for the dimension of the cointegration space as well as to run weak exogeneity tests on some of the variables, most notably the capital stock, w.r.t. the parameters of the cointegration relationship among four variables in our system. Appendix IIA gives the relevant summary tables from the (unrestricted) cointegration analysis[20]. According to Table II.1b, both the maximal and trace test, in the uncorrected form in particular, seem to suggest that the cointegration rank be 1, i.e. there is evidence of one cointegration relationship between the unemployment rate, real consumption wage, capital stock and terms of trade in Finland. The unrestricted estimates of the -matrix as well as of the loading matrix (vector) corresponding to the proposed cointegration vector - maximal eigenvalue or canonical correlation - (emboldened) are shown in Table II.1c.

Given that the cointegration dimension is one, the estimated cointegration vector appears to be reasonable from an economic point of view. In particular, if we could conclude that it is an unemployment equation, the signs of the individual coefficients are consistent with theory, although they are perhaps a little too large (in absolute value).

Overall, then, Table II.1c seems to suggest that the following linear combination of the unemployment rate, real consumption wage, capital stock as well as the terms of trade in the Finnish data, normalised by the unemployment rate,

$$ECM_t = \hat{b}' X_t = u_t - 3.23\, w_t + 1.53\, k_t + 1.63\, q_t \qquad (11)$$

(where the hat signifies 'estimated'), is stationary, i.e. I(0). The corresponding standardised (factor) loadings in Table II.1d, which interpret the effect of the disequilibrium error corrected for lagged differences[21], indicate stable error correction dynamics.

The structure of the estimated loading matrix has an interesting structure. In the present context we can write the VECM as

$$\Delta X_t^{FI} = \begin{pmatrix} \Delta u_t \\ \Delta w_t \\ \Delta k_t \\ \Delta q_t \end{pmatrix} = \begin{pmatrix} -0.341 \\ -0.011 \\ -0.001 \\ -0.027 \end{pmatrix} (u_{t-1} - 3.322\, w_{t-1} + 1.526\, k_{t-1} + 1.626\, q_{t-1}) + \sum_{j=1}^{3} \hat{\Gamma}_j \Delta X_{t-j}^{FI} + \hat{e}_t^{FI}$$

(12)

Table II.1d seems to suggest that the factor loading on the capital stock is zero, and very small on real wages and perhaps also on the terms of trade. We tested the hypothesis of zero loading on the capital stock using Johansen s likelihood ratio test [22].

We also tested for the weak exogeneity of the capital stock and real wage for the long-run parameters, because it is an interesting hypothesis in itself in the sense that if not rejected it implies that real wages are not error correcting. Unemployment, on the other hand, will respond to all sources of exogenous shocks directly and through endogenous adjustment[23]. This hypothesis cannot be rejected (p-value is 0.605). Finally, we tested for the weak exogeneity of the capital stock, real wages and terms of trade for the parameters of the cointegrating relations. The p-value drops drastically, to 0.059, so that formally this hypothesis is a borderline case. The estimated unrestricted vector is now (1.003, -2.864, 1.154, 1.166)[24]. It should, however, be noted that though formally a borderline case, the sharp drop in the p-value in the last exogeneity test is perhaps best interpreted as a warning. The numerical test results should not be taken at face value and interpreted too rigidly to avoid running the risk of accepting too easily. In order to check for this possibility, we tested for the weak exogeneity of the terms of trade alone w.r.t. the long-run parameters and the test result has a low p-value of 0.065. Once again, this is formally a borderline case, but strongly suggesting that the terms of trade is, in the end, not weakly exogenous.

Finally, we re-estimated the system with the (log of the) capital stock replaced by the growth rate of the capital stock (i.e. log-difference of the capital stock). We wanted to see, whether there was any effect on the results from taking the capital stock as an I(2)-process (see fn. 36). Test results do indicate that the cointegration rank is one and the unrestricted estimates of the components of the cointegration vector are now much smaller. The original estimates are, as argued earlier, probably a little too large (in absolute terms), so the present ones appear to imply a move to the right direction. Weak exogeneity tests suggest that the growth rate of the capital stock is weakly exogenous - the p-value is 0.229 - and there is now stronger evidence also of the weak exogeneity of real wages; the p-value is 0.329 for the weak exogeneity of the growth rate of the capital stock and real wages jointly. Adding the terms of trade to list results, once again, in the p-value dropping sharply to p = 0.1. Finally, these results did not change much, when we added two impulse dummies - corresponding to 1989.1 and 1990.1 - to control for the observed ARCH-type behaviour of the growth rate of the capital stock observed also earlier in the context of the unit root tests (see fn. 37). Evidence in favour of the weak exogeneity of the capital stock and real wages (and perhaps also of the terms of trade) is slightly stronger in this case.

2.2 Results for New Zealand

This section is only a summary as our focus is on the Nordic countries. The full explanation is to be found in Mayes and Vilumnen (1998). Semi-annual data were not available for New Zealand, so that the empirical analysis is conducted using annual data over the period 1960 - 1995. This implies that there are fewer observations available than in the Finnish case, even though the time span of the sample is the same. Also, because of time aggregation, caution must be exercised when making comparisons with results from the Finnish data. The New Zealand data also present some problems in interpretation and require caution in assuming the appropriate order of integration. Again only one cointegrating vector is found. The ordering of the variables in the estimated cointegration vector is different from the one used for Finland. The reason is that the data seem to suggest that the terms of trade, in particular, is error correcting, i.e. changes in the terms of trade constitute an important short-run dynamic channel whereby the New Zealand economy adjusts to shocks.

2.3 *The two countries compared*

For Finland the data seem to suggest a model, where the capital stock is taken as (weakly) exogenous to the long-run parameters, i.e. the capital stock is not error correcting w.r.t. shocks to the cointegration relationship, which can be regarded as an unemployment relationship. At conventional significance levels at least, formal tests indicate that we could also take real wages and terms of trade as (weakly) exogenous. Since we are primarily interested how the burden of adjustment to shocks to the unemployment relationship is distributed across unemployment, real wages and terms of trade in countries like Finland and New Zealand, we will focus on the relevant error correction representations of the cointegrated system of variables. In the Finnish case, we have

from (12)

$$\Delta X_t^{FI} = \begin{pmatrix} \Delta u_t \\ \Delta w_t \\ \Delta k_t \\ \Delta q_t \end{pmatrix} = \begin{pmatrix} -0.34 \\ -0.01 \\ 0 \\ -0.03 \end{pmatrix} (u_{t-1} - 3.32\, w_{t-1} + 1.53\, k_{t-1} + 1.63\, q_{t-1}) + \sum_{j=1}^{3} \hat{\Gamma}_j \Delta X_{t-j}^{FI} + \hat{e}_t^{FI}$$

(13)

where a zero factor loading has been imposed on the capital stock, *k*.

Equation (13) suggests that the bulk of the short-run adjustment to a shock to the unemployment relation falls on unemployment. The speed of adjustment of unemployment is also relatively fast, whereas real wages and perhaps also terms of trade adjust only sluggishly; unemployment will adjust at a speed of 0.34 percentage points per 6 months to a unit shock to the long-run unemployment relationship (e.g. a permanent fall in the capital stock), while the adjustment speed of real wages is as low as 0.01 percentage points per 6 months. In the light of evidence from other studies of the flexibility of wages to unemployment, this point estimate may be towards the low end of the range of estimates obtained[25].

The finding that real wages are only mildly error correcting may be associated with real wage rigidity which, together with slightly stronger error correction on the terms of trade, in turn could be related to the wage formation under centralised wage bargaining and fixed exchange rates with fairly regular devaluations that characterised Finland over much of the period. On the basis of this evidence, it may be extremely difficult to achieve real wage adjustments, in the face of adverse shocks to employment, through nominal wage cuts in an economy like Finland.

Finland, along with other Nordic countries, has often been considered as an archetype of *social corporatism*, i.e. an economic system whose labour market is characterised by two basic features: i) centralised wage bargaining and ii) formal or informal involvement of the government economic and social policies in the process (Pekkarinen *et al.* 1992, p. 2; see also Vartiainen 1995). In Finland the wage bargaining process has typically been a two- or three tier process, with a centralised agreement, an agreement signed by industrial unions and the corresponding employers' associations and adjustments at the plant or firm level agreed by the workers' and employers' representatives. In the successive tiers after the centralised agreement, there is strong bias towards positive wage drift, which has not always been fully anticipated at the central level. Unions tend to improve upon the central agreement, and plant level applications usually involve (options for) positive adjustments to union level wage rates (see also Vartiainen 1995, pp. 4-6). Holden (1991) has formally proven - using Nash bargaining theory - that the existence of collective agreements changes the threat points of wage bargains at the lower level of bargaining in a way that generates positive

wage drift. Furthermore this multi-tier scheme tends to work better in an environment with some inflation, since when inflation is low, some nominal wages may need to be cut to achieve a given aggregate outcome.

Devaluations of the domestic currency in bad times - trying to counteract a fall in the price level - contribute to making nominal wage cuts unnecessary. The implications here is, thus, that real wage flexibility in Finland, if there has been any, has been at least partly the result of monetary and exchange rate policy. There is an empirical content in this claim - more corporatist economies have 'softer' exchange rate policies - and it certainly qualifies the interpretation of the Calmfors - Driffill 'smile' (Calmfors and Driffill 1988; see also Pohjola 1992). Tabellini's analysis of discretionary monetary policy equilibria under centralised wage setting could probably provide a formal setting for the analysis of this claim (Tabellini 1988, pp. 105-6). It could be argued that Austria is a clear exception but Austria is also an exception in the sense that it has not performed so well in terms of (changes in) employment. Although its record seems to be good in terms of (changes in) unemployment (see e.g. Pohjola 1992, pp. 51 -52, graphs 3.3 - 3.6).

This distribution of the burden of adjustment has important policy implications, because not only does unemployment display substantial hysteresis, which tends to make shocks to unemployment highly persistent, but the low (endogenous) response of wages and the terms of trade to labour market shocks provides a very weak cushion against unemployment increases in the presence of adverse shocks. The low response of real wages contributes to making unemployment increasingly exposed to shocks; i.e. increases the likelihood of poor unemployment performance of the economy in the presence of adverse shocks. This, in turn, contributes to the possibility of sharp increases and subsequently low convergence of the unemployment rate. Since the factor loadings depend on a variety of institutional and structural features of the labour market[26], this implies policy efforts should be directed to those reforms that, in addition to measures that potentially reduce hysteresis in unemployment, redistribute the burden of short-run adjustment away from unemployment. This involves, inter alia, increasing the unemployment responsiveness of real wages in the economy[27].

In the case of New Zealand, on the other hand, the evidence may be more difficult to interpret from the point of view of labour market adjustment, because uncertainty in the parameter estimates, in particular of the factor loadings, appears to be larger than for Finland. It is also more difficult because the evidence in the data in favour of a long-term unemployment equation seems to be much weaker than for Finland. Furthermore, comparison with the result from the Finnish data is complicated by the fact that the New Zealand data are annual.

Although there is strong evidence in favour of cointegration among the terms of trade, real consumption wages, rate of unemployment and capital stock in the data from New Zealand, with the hypothesis of cointegration only among the subset of variables decisively rejected by the data, re-

sults from weak exogeneity tests indicate that we have essentially estimated a long-term 'terms of trade equation' of the form $X_t = q_t + 0.14u_t + 0.73w_t - 0.37k_t$ with the associated loading matrix $= (-1.09, -0.13, -0.13, 0)'$ from the data. Hence, the data appear to suggest that the error correction form of the cointegrated system for New Zealand is

$$\Delta X_t^{NZ} = \begin{pmatrix} \Delta q_t \\ \Delta u_t \\ \Delta w_t \\ \Delta k_t \end{pmatrix} = \begin{pmatrix} -1.09 \\ -0.13 \\ -0.13 \\ 0 \end{pmatrix} (q_{t-1} + 0.14\, u_{t-1} + 0.14\, w_{t-1} - 0.37\, k_{t-1}) + \sum_{j=1}^{1} \hat{\Gamma}_j \Delta X_{t-j}^{NZ} + \hat{e}_t^{NZ}$$

(14)

Formally, the sample may just be too small and, hence, the estimated factor loadings too imprecise for us to be able to infer the correct VECM. However, some observations are warranted on the basis of the estimated VECM in (14). First of all the unemployment rate in New Zealand has swung sharply during the last 10 - 15 years: from 4 % in 1984 to 11 % in 1992 and stabilising around 7 % in 1996-7. Hence, as these figures indicate labour market adjustment through unemployment can be sizable; whether it is 1.9 percentage points p.a. for a unit shock to the long-run equilibrium, as the unrestricted loading estimates indicate is another matter. Formal tests indicate that, under $r = 1$ and weakly exogenous capital stock, one can reduce the factor loading of the (growth of the) unemployment rate by as much as 1.5 percentage point with essentially no reduction in the test statistic.

Second, the numerical estimates of the factor loadings in (14) (and in the unrestricted case) indicate larger factor loading on real wages than in Finland. Hence, real wages appear to be more strongly error correcting in New Zealand than in Finland. This means that the rate of convergence of real wages to the long-run equilibrium is more rapid in New Zealand than in Finland[28].

Third, terms of trade movements appear to be an important adjustment channel to shocks to the long-run equilibrium in the New Zealand economy. As we have noted, formal tests decisively rejected the hypothesis that the terms of trade is weakly exogenous to the parameters of the long-run equilibrium. In the context of a sticky price model, like the one in Section 2, nominal exchange rate movements are perhaps the most important single source of terms of trade movements in an open economy, and this 'sticky price logic' may actually explain the signs of the estimated coefficients in the cointegrating vector, with the capital stock capturing important supply side effects on the nominal value of the New Zealand currency[29]. Furthermore, the rate of convergence of the terms of trade to the long-run equilibrium is rapid and certainly faster than in Finland.

We thus see two very different labour markets but both seem to have coherence over the period as a whole. As noted by Chapple, Harris and Silverstone (1996) New Zealand adjusted quite flexibly even before the reform programme of the last fifteen years. Finland on the other hand did not adjust readily even when it had a floating exchange rate. It will therefore need new mechanisms if it is to respond more flexibly under Stage 3 of EMU. However, experience of the last year suggests that it has already been possible to have a faster rate of economic growth consistent with price stability as the new market pressures from membership of the euro area are anticipated. Thus, while it may be too early to identify structural breaks, they may become obvious with time. Centralised bargaining may permit more flexible wage adjustment in monetary union. The lesson from both countries may turn out to be that institutional change outside the labour market can nevertheless have a clear effect on the way the labour market adjusts to external shocks.

3 EMU and the structure of wage bargaining

We saw in the previous section that New Zealand and Finland exhibit very different labour market characteristics. If Finnish unemployment is to continue to fall at recent rates then Finland will either have to continue receive a sequence of favourable shocks under EMU or its labour market behaviour will have to change. To some extent EMU in itself is providing such favourable shocks. Real interest rates are already clearly below the levels that would have been likely without EMU. The euro has fallen in value and assisted Finland's continued export growth, particularly in highly competitive industries such as electronics.

A second question we now address is whether the particular structure chosen for the ECB will tend to help the adjustment of the euro countries given the structure of their wage bargaining systems. We therefore need on the one hand to decide whether the institutional structure of the ECB itself will tend to offer a more promising environment for the reduction of unemployment than its predecessor national central banks. On the other, our particular interest is whether countries with a centralised and co-ordinated bargaining system like Finland may be able to continue to drive down unemployment relative to the euro average. More than that whether they can respond more flexibly to symmetric shocks than some other euro countries. In other words a much wider concern than just the popular question of whether they can respond to asymmetric shocks with limited cost.

Many studies have empirically tested whether higher central bank independence is related to macroeconomic performance in OECD countries with fairly robust observation that inflation is negatively correlated with the measures of legal independence of the central bank. However, the evidence that having independent and conservative central banker is like having a free lunch, that is, an increased central bank independence has actually translated into a better credibility, is inconclusive. Different legal measures of central bank independence seem not to be correlated with output or employment volatility as predicted by the standard credibility model of monetary policy. Parkin (1987), Grilli et al. (1991), Alesina and Summers (1993) show that higher central bank independence yields lowered inflation without costs in output. Posen (1994), Debelle and Fischer

(1994), in turn, show that higher central bank independence has not translated into lowered costs of disinflation. This has been seen as evidence against the credibility arguments. It is thus not immediately clear from this evidence what the establishment of the ECB will itself offer for unemployment just from its more independent structure.

Furthermore, the debate on monetary policy has somewhat ignored the role of the private sector in successful monetary policy and inflation control. Although there is another line of inquiry where the private sector's behaviour, the management of wage setting in particular, has been seen as a major element in successful economic policy.[30]

Instead of the government 'tying its hands' in economic policies, as suggested in the standard credibility literature, this literature suggests that flexible full employment policies (demand management) are crucial in facilitating a co-operation between labour and capital. Bruno and Sachs (1985) suggest that the relationship between centralisation of wage bargaining, unemployment performance and wage restraint is positive and linear, implying that a more centralised wage setting system would yield a superior macroeconomic performance. In contrast, Calmfors and Driffill (1988) and Freeman (1988) demonstrate that extremes perform the best. In other words, either a highly centralised system with national bargaining or a highly decentralised system with a wage setting at the level of individual firms perform better than with and an industry level bargaining structure (Calmfors, 1988). More recent empirical evidence, however, has produced rather mixed results (Traxler (1994), Scarpetta (1996), OECD (1997) and if anything, empirical evidence is inconclusive.

Our basic argument is that monetary and labour market institutions interact in the delivery of successful macroeconomic policy. Indeed, some attempts have already been made to combine the debate on the centralisation of wage bargaining and central bank independence.[31] Bleaney (1996) argues that theoretically inflation performance should not depend upon the characteristics of wage bargaining but only on the monetary regime and central bank independence, while unemployment should depend both on the central bank independence and the wage bargaining structure. However, Akhand (1992), Cubit (1993) and Skott (1995) show that inflation performance should also be conditional on the wage bargaining structure. Skott (1995) also shows theoretically that if also the unions are inflation averse, countries may perform well despite a central bank's concern on output. There are few empirical studies that combine these different aspects. Cukierman and Lippi (1998) suggest that when the central bank independence in moderate, there is a clear hump-shaped relationship between unemployment and centralisation of wage bargaining. Their evidence also shows that the inflation-reducing impact of central bank independence is largest when centralisation of wage bargaining is an intermediate level.

Bleaney (1996) and Iversen (1998) have tested empirically some of the implications of this literature. While Bleaney (1996) confirms his theoretical findings, Iversen (1998) shows that unemploy-

ment performance depends upon degree of discretion of monetary policy as well as the degree of centralisation of wage bargaining.

3.1 Modelling Central Bank Structures

Most of the existing attempts at the systematic characterisation of central bank independence and empirical studies rely on legal aspects of independence, such as Alesina (1993), Grilli, Masciandaro and Tabellini(1991), Cukierman (1992) and Eijffinger and Schaling (1995). The concept of independence used also in our empirical analysis proxies the legal independence that is considered to be an essential component of actual independence. The legal independence inherently suggests what degree of independence legislators meant to confer on the central bank. (Cukierman, 1992).

According to Hasse (1990) central bank independence relates to three areas in which the influence of government must be either excluded or cushioned. Those prominent areas are independence in personnel matters, financial independence, and independence with respect to policy. Personnel independence refers to the influence the government has in the appointment procedures of the governing board of the central bank. Financial independence refers to the limitations on lending from the bank to the public. Policy independence refers to the manoeuvring room given to the central bank in the formulation and execution of monetary policy. The policy independence can be further classified according to goal and instrument independence, as suggested by Debelle and Fischer (1994), Eijffinger and De Haan (1996).

Table 1 shows some summary indices of the central bank independence that have been used in the recent literature. Comparison between different indices is a fairly difficult task due to the different methods of assessing independence of the central banks. While Alesina, Grilli *et al.* and Eijffinger and Schaling use a rather crude measure, Cukierman's and modified index of Cukierman developed in this paper (KICBI), facilitate ranking of the countries in more detail. In order to facilitate graphical comparison, we have standardised different indices in Fig. 1 and ranked them according to KICBI index. Moreover, we have calculated Spearman's rank correlation between Cukierman's and our own index as well as between Alesina, Eijffinger and Schaling and Grilli et al.

Fig. 2 shows fairly substantial differences between the ranking of countries according to different indices. However, rank correlations in table 2. show that indices are reasonably highly correlated. Differences are due to the differences in measurement methods as well due to the high subjectivity in the assessment of central bank laws. For instance, Grilli et al. assess the (political) independence of the Reserve Bank of New Zealand as the least independent, while Cukierman and Kilponen rank the RBNZ as having a medium independence. Different indices seem to agree relatively well between the central banks that have been ranked the most independent, such as US, Switzerland and Germany.

Most commonly used summary indices of legal independence of the central banks, such as those presented in the table 1, might not provide an comprehensive measure of actual central bank independence. For instance, when studying a link between the central bank independence and the budget deficits, the most important factor is financial independence. When judging the relationship between inflation and central bank independence, the political independence may play the most important role. Often a lack of, say, goal independence and personnel independence has been supplemented by the instrument independence, as in the case of New Zealand and other inflation targeting countries (Eijffinger and de Haan, 1996). Sometimes, a lack of, say, financial independence may mitigate the political independence as in the case of the Bank of Italy. Therefore, in empirical analysis, one should control for the different forms of legal independence and not to use only the highly aggregated summary measures of legal independence.

Moreover, existing indices of legal independence are often incomplete and noisy indicators of actual independence and subject to subjectivity bias, as noted by Mangano (1998). This subjectivity bias is judged by comparing the values attributed on common legal characteristics of central banks by Grilli *et al.* and Cukierman. In general, Mangano finds that Cukierman and Grilli *et al.* disagree nearly 60% of countries when deciding whether the central bank is legally allowed to purchase government debts in the primary markets or not. Virtually a third of the values attributed to their common criteria seem to be subject to conflicting interpretations. In addition, as noted by Eijffinger and de Haan (1996), Cukierman attributes an incorrect value to five out of the 16 characteristics by which he measures the legal independence of the Dutch central bank. However, Cukierman's index contains the largest set of countries and is perhaps the most comprehensive attempt to assess legal independence. For instance, Grilli *et al.* index excludes all the Scandinavian countries, that are of substantial interest in our study and separates a form of independence only into two categories; financial and economic independence.

Consequently, although the indices of legal aspects of central bank independence and their coding used in our empirical analysis are based closely on Cukierman's (1992) indices, our measure of financial independence differs from Cukierman (1992). We have also reassessed the independence of the Dutch Central bank and corrected the values following Eijffinger and de Haan. We also account for the adoption of inflation targeting, by constructing a dummy for those countries that adopted inflation targeting, as well as for the recent changes in central bank laws. Corresponding changes and their effect on the legal independence are explained in appendix table III.1. Table 1 summarises effects of those changes on an overall legal independence of the central banks and highlights the countries that have adopted explicit inflation targets towards the end of 1996. This allows us to extend the time period until 1996 and study the effects of these important changes on macroeconomic performance. The legal independence considers 3 different periods, 1972-9, 1980-9, and 1990-6, so that the legal variables of the central bank independence are coded separately for each subperiod.

Given that OECD countries have adopted different practices in securing the legal independence of their central banks, it is interesting compare these different forms of independence according to our measures. We have therefore ranked the countries according to each political independence, personnel independence, financial independence and importance of price objective in the status of the central banks and produced a Spearman rank correlation between different forms of independence during 1980-1989 and 1990-1996. Apparently, also these indices capture substantial differences in the ranking of the countries according to different forms of independence. This is evident from fig. 2 and Table 3 below.

Fig. 2 reveals that some forms of legal independence are relatively loosely linked to each others. This loose link is also quantified in table 3 by rank correlations. In general, while the financial independence and the importance of price objective in the status of the central bank seem to be closely related, policy independence and financial independence are very loosely linked. It is also interesting to note that for instance the Danish central bank seems to have very high political and financial independence, while no personnel independence. A similar kind of substantial difference appears also in the case of Canada, the Netherlands and Finland. On the contrary, the Bundesbank is ranked as having a very high independence according to all variables. Consequently, in many countries, there exist a degree of uncertainty with regard to legal independence of the central banks and it seems that the governments have nevertheless attempted to maintain some channel for discretion on their central banks.

The ECB does not feature in these comparisons as it did not exist at the time but the ECB has been given complete political independence as well as goal and instrument independence. The ECB has freedom on the monetary policy instruments to pursue price stability bound only by the principle of respecting market laws. It can set its own inflation goal, consistent with the requirement of price stability. The ECB has announced a quantified definition of price stability (inflation of 2% or less over the medium term). Moreover, due to the appointment and dismiss procedures the members of the Governing Council have only limited political accountability. The Executive Board members are appointed for an eight-year non-renewable term. The ECB is prohibited from taking or seeking instructions from other bodies. A different question is, how the ECB can monitor its own actions and enforce itself to maintain price stability. The question is, literally, how can it tie its own hands? There are few assessments of its position in the spectrum but that by Castren (1998) suggests that by most of the measures considered here the ECB will be right towards the upper limit of independence shown by existing national central banks. Indeed its relatively low level of formal accountability may put it in a new category of its own.

3.2 Modelling Wage Bargaining Structures

At the beginning of the 1980s, a vast political economy literature concentrated on the macroeconomic consequences of various wage-bargaining systems. It was thought that wage bargaining

structure could explain part of the dispersion of macroeconomic performance in advanced industrialised countries. In particular, some wage bargaining systems were seen to have higher wage restraint.

One of the starting points of this literature was Bruno and Sachs (1985) who argued that

> 'A real wage moderation is a key to achieving low inflation and low unemployment after a supply shocks. …In countries with near-universal union coverage and highly centralised negotiations (for example Austria and Sweden) it seems that wages were kept closer to market clearing levels than in more decentralised systems (such as the United Kingdom)'

That is, the relationship between centralisation, unemployment performance and wage restraint seemed to be linear, implying that a more centralised wage setting system would yield a higher wage restraint and thus lower unemployment rates.

In contrast, Calmfors and Driffill (1988) and Freeman (1988) demonstrated that extremes perform the best. In other words, either a highly centralised system with national bargaining or a highly decentralised system with a wage setting at the level of individual firms perform better than those with an industry level bargaining structure. Calmfors (1988) explained this by the idea of Olson (1965) who stated that organised interests may be most harmful when they are strong enough to cause major disruptions but not sufficiently encompassing to bear any significant fraction of the costs for society of their actions in their own interest. (Olson, 1965).

The first view emphasises the fact that a high degree of centralisation guarantees that wage setters recognise broader interests. According to this view, institutional arrangements exist to overcome various market failures and may therefore benefit economic performance. This view has been criticised by the insider-outsider view, according to which union officials may not bear enough concern for outsiders mitigating the possibility of union officials 'recognise a broader interest'.[32] The second view emphasises the role of market forces (competition) in securing the optimal combination of real wage and employment. In contrast to the first view, non-market institutions are 'rigidities' which only harm economic performance.

The Calmfors-Driffill hypothesis supported the view that the degree of centralisation of union power is the central attribute that determines union behaviour and its impact on the national economy. Calmfors and Driffill (1988) constructed an index of centralisation by assessing the co-ordination level within national union confederations and within national employer organisations and the existence of parallel central organisations and their co-operation. Centralisation is then, in fact, defined and measured by the extent of co-operation between different unions and employer organisations in wage bargaining.

However, Golden (1993) emphasises the coercive authority of central confederations over its affiliates (unions). The degree of centralisation and the level at which bargaining predominantly takes place depends on the institutional conditions such as the extent to which national confederations (peak organisations) have authority over its unions. The coercive authority appears as the extent to which the peak organisations are able to set wage demands, sanction strikes action and generally disperse union resources. The difference between Golden's definition and Calmfors and Driffill's definition is that she defines centralisation as the formal centralisation of authority between unions and their peak organisations, while Calmfors and Driffill considered centralisation from a broader perspective, combining formal centralisation and co-operation. (Golden, 1993)

The basic insight of Golden's (1993) analysis is that the centralisation of authority may not be enough to secure sustained wage moderation and better economic performance. This is because the binding/coercive authority that central confederations hold over their affiliates is ultimately voluntary and thus this authority is more likely to rest on bargaining and agreement among the parties. According to the OECD (1997) report, the fact that in highly centralised wage bargaining countries wages tend to drift supports this argument. Because the extent of co-ordination and formal authority are separate independent features of wage bargaining and may evolve in a different direction over time, it may not be appropriate to combine these under the same heading, as in the Calmfors and Driffill index.

Given this conceptual difficulty with defining centralisation, Golden (1993) argues that a lack of co-operation that is potentially harmful for the aggregate economy can be avoided even without the formal authority of confederations, provided that institutional conditions facilitate the co-ordination of bargaining strategies among unions. This view, primarily due to the Lange (1984) and Wallerstein (1990), emphasises the collective action problem affecting union behaviour. According to this line of argument co-operation among workers and among unions may be difficult to achieve, because of problems of free riding. The idea is that even if workers and unions collectively prefer wage restraint, it is in no individual worker's or union's interest to do so. This idea has been formalised for instance in monopolistic competition models. Also Soskice (1990) emphasises the role of co-ordination separately from the formal degree of centralisation and shows that the hump-shaped relationship between a wage restraint and a degree of centralisation disappears when the degree of co-ordination is evaluated separately from centralisation.

The possibility for co-ordination, in turn, is likely to rest on two factors:

(i) The number of national-level actors involved in the wage setting process.
(ii) The degree of competition among them

The first indicates the unconditional likelihood that labour is able to overcome internal co-ordination problems and the second the likelihood that it resolves internal distributional conflicts. When the

number of unions that participate in the wage bargaining is small, unions can monitor and assess their own and each other's behaviour in the bargaining process, thus reducing the uncertainties that can be harmful in the wage bargaining process. The second refers to the fact, that not all union problems are simply co-ordination problems that can be eased by reducing the number of actors involved; inter- and intra-union relations are characterised by genuine conflicts of interest as well. The problem of competition, in turn, can be eased by demarcating non-overlapping union territories and thus, reducing the competition from members. When fewer but larger unions set wages for larger groups of workers the visibility and organisational importance for workers of relative wages can be increased. These together should moderate wage demands, reduce inflationary pressure and help to maintain high employment.

More centralised and co-ordinated wage bargaining institutions promote credence of monetary policy due to their better ability to co-ordinate and assess the behaviour of the others. This is because in the centralised and co-ordinated wage setting systems possibly harmful uncertainty on the actions of the others is reduced, when compared with the wage bargaining systems where several competing unions are involved. On the other hand, possibility that sufficiently centralised wage bargaining institutions use their monopoly power, leading to higher wage inflation, may mitigate the effect of this higher credence. In the face of decentralised wage setting institutions, in turn, the monetary policy may suffer a lack of credence, but the ultimate question is, whether a lack of credence outweighs the benefit from reasonably well functioning and flexible market mechanism in wage setting. It is therefore important to note that the degree of centralisation and the degree of co-operation in wage bargaining are conceptually different issues in the context of credence as well. The critical point is that while the higher degree of co-ordination should inevitably promote this credence and improve macroeconomic performance, the higher degree of centralisation may work in the opposite direction. This is due to the fact that a higher degree of centralisation inevitably increases the market power of the unions.

Also Golden (1993) refers to this same phenomenon by ‘visibility’, which inherently decreases uncertainties about the actions of the others in the wage bargaining process. However, Golden (1993) does not notice that an increased centralisation may lead higher wages, due to the exploitation of market power. We turn to this after considering the measurement of co-ordination and centralisation of wage bargaining.

Unfortunately, no simple or even comprehensive combination of measures exists that would account for all these factors. The best available source for the data is OECD (1997), where the Calmfors-Driffill (1988) index has been extended. OECD (1997) evaluates the degree of formal centralisation in wage bargaining separately from co-ordination. Table 2 below reproduces these figures.

From Table 2 we can see that the degree of centralisation and co-operation are quite closely related. However, interesting exceptions are those where the degree of centralisation has been higher than the degree of co-ordination. This was the case in Belgium, Finland, France, Italy, New Zealand, Spain, Sweden and the U.K. during the 1980s, while the situation remained similar only in the U.K in 1994. These countries may represent the most unfavourable bargaining systems, since in these countries the market power of the unions has been considerable, while the likelihood for inter- and intra union conflicts of interest perhaps the greatest. In all other countries, the degree of co-operation has been at least as large as the degree of centralisation. The difference between centralisation and co-operation is particularly large in Austria, Germany and Japan. In those countries industry level or decentralised wage bargaining systems seem to be characterised by genuine co-operation. We should expect this to improve the performance of these systems.

Ultimately wage bargaining is a process of decision making between the parties representing employer and employee interests. The key element in the decision making process between union and employer is the ability of both sides to halt production. The firm's power depends on the right to lockout or fire, while the union's power depends on the right to organise and strike. Formally, the external power of the unions and confederations is upheld by a statute and therefore it is more than likely that institutional conditions play a dominant role in the wage setting game between the firms and unions (Layard, 1991; Soskice,1990).

Jackman *et al.* (1991) have analysed the issue in a simple model of bargaining between unions and firms. Under reasonable assumptions, the rise in union power leads to relative wage increases and a fall in aggregate employment. An increase in union coverage increases union employment and total employment rises. However, if the supply in the competitive sector is elastic enough, a rise in union coverage depresses the competitive sector wages and leads to fall in employment. This result is increasingly likely the nearer one is to complete unionisation. (In general, over most relevant ranges an increase in coverage reduces total employment.)

Conceptually, external union power is a complex matter and thus difficult to assess. Often, union density, which is the proportion of eligible employees who become union members, has been considered as an initial but fundamental measure of union power. Union coverage, instead, is often in effect larger than the union density because statutory and other requirements extend the collectively-bargained wage to non-union employees. Union coverage is perhaps a more accurate measure of the extent to which unions affect wage levels than union density and for this reason maybe also more accurate measure of union power. In the empirical analysis, however, it turns out that neither the density nor the coverage rates alone can explain inflation, wage growth or unemployment. The reason is that union density nor union coverage as such does not tell anything about the actual monopoly power of the individual unions. The density and coverage can be high even in reasonable decentralised and non-co-operative wage bargaining systems as can be seen by comparing Tables 4 and 5.

We therefore propose an alternative measure of union power by multiplying the degree of centralisation and union density (MOPO). This measure of monopoly power of the unions takes into account the fact that in more centralised wage bargaining systems, a high density promotes monopoly power, while in highly decentralised systems high density does not secure monopoly power of the individual union.

From Table 5 we can see that the rates of union coverage and union density differ across countries by wide margins. This is evident from only a modest positive correlation ($r = 0.32$)[33] between the two rates. Several groups of countries can be identified. First, there is a group - Canada, Japan and United States - with below average coverage and unionisation with little difference between them. Another group - Finland, Norway and Sweden, features very high unionisation and coverage rates with a relatively modest difference between them. The most interesting are perhaps the countries with considerable differences between the two. The gap is especially wide in France, but also significant in countries such as Austria, Germany, the Netherlands, Spain and Italy.

A large difference between density and coverage rates may reflect the organisational weakness of the labour movement and intra-union conflicts, which are then compensated by political decisions of extension laws and statutory arrangements or by genuine co-operation of employer organisations. A likelihood that intra-union conflicts lead into wage rivalry is perhaps higher when compared to systems with more uniform density and coverage rates. Moreover, if the union membership gives an insider advantage for the members per se, the non-union members do not enter into wage considerations in the wage bargaining process. This can lead into "too high" wage demands and exploitation of insider advantage. In order to assess importance of large differences between these two rates, we constructed a new variable by subtracting union density from the union coverage (DICODE). The higher the value, higher the likelihood of free rider problems. In the empirical analysis, this variable partially explains the dispersion in wage growth and unemployment rates in OECD countries.

3.3 *The model*

In order to assess the statistical significance of these institutional structures and reforms, we estimated a cross-section-time-series model for inflation, nominal wage growth and unemployment rates. In contrast with other studies of this kind, we estimate a fully specified econometric model, extended with institutional variables for each of price inflation, unemployment and wage inflation. We also account for endogeneity of the regressors and use specification tests to compare between different models. The endogeneity problem arises from the fact that inflation, wage growth and unemployment are jointly determined.

Primarily, our interest is to test whether, and how, inclusion of wage bargaining variables together with different measures of central bank independence discussed above helps to explain variation in

macroeconomic performance in OECD countries during the period of 1973-96. We are also interested in whether the Calmfors-Driffill hypothesis of hump-shaped relationship between wage growth and the degree of centralisation on the one hand and unemployment and the degree of centralisation on the other hand, gets support from the data. This section presents and discusses the results.

We estimated the following equation for each of price inflation, wage inflation and unemployment (Portugal, Greece and Ireland were excluded from the estimated models due to lack of data).

$$\begin{aligned} y_{it} &= dy_{it-1} + x_{it}'b + Z_{it}l + g_t + u_{it}, i = 1,...N \\ u_{it} &\sim iid \end{aligned} \qquad (15)$$

Where y_{it} refers to dependent variable, x_{it} economic variables, β to corresponding parameters, Z_{it} to institutional variables, λ to corresponding parameter vector, g_t common time effects and finally u_{it} to error term. Index i refers to countries(cross-sections) and t to time.

The endogeneity problem related to economic variables was accounted for by instrumental variable estimation. Lagged values of explanatory economic variables were used as instruments. Institutional variables were not included into the instrument equation, in order to avoid orthogonality between instrumented regressors and institutional variables. Finally, we used growth rates of each country as an additional instrument.

The lagged dependent variable was included into the model in order to remove serial correlation from the errors. A lagged dependent variable also captures the dynamic adjustment, since dependent variables exhibit a substantial degree of persistence in each equation. Serial correlation of the errors was then tested by a Lagrange Multiplier test Lm (Baltagi, 1995, p. 92, eq. (5.38)). In the models for price inflation and wage growth, a lagged dependent variable and other explanatory economic variables were able to remove serial correlation from the errors. In the case of unemployment it was necessary to include the lagged change in unemployment and other economic variables as well.[34]

Time effects (g_t were also included into the model, when appropriate. These time effects are country-invariant and account for any time-specific effects not included in the regression, such as oil shocks. Time effects can also mimic the general trend in the dependent variables, such as declining world inflation. Time effects in the errors was then tested by a Lagrange Multiplier test (LM), (Baltagi, 1995, eq. (4.42)). The model misspecification was tested by testing whether individual effects should be included into errors. Again a Lagrange Multiplier test (LM), (Baltagi, 1995, eq.(4.38)), was used. Finally the possibility that errors were correlated and heteroskedastic across countries was tested by a Likelihood Ratio test, comparing the restricted and unrestricted model.

The model specification was accepted when the model passed all these specification tests. Normality of the errors was also assessed using the test statistic. None of the models passed this test, however. This is not surprising, given the data at hand, since outliers are highly likely. Although OLS estimation was used to estimate parameters of interest, robust standard errors were calculated following the method of Beck and Katz (1995).

After these two estimation rounds, we ran instrumental variable regressions for each of price inflation, wage growth and unemployment without the labour market variables. Our idea was to test whether exclusion of the labour market variables led to a misspecified model. A Lagrange Multiplier test, which tested jointly whether errors contained significant individual effects and whether the errors were serially correlated, tested this misspecification from the partial model (LM ,), Baltagi (1995, eq. (5.36).). In addition, we used a Wald test to test for joint significance of the labour market variables in the fully specified model. Finally, also the Calmfors-Driffill hypothesis was tested by a Wald test from fully specified model. The estimates and hypothesis tests are summarised in Tables 6 and 7 respectively.

Our model for inflation suggests that the importance of price stability objective in the status of the central bank (OBJE), which proxies the conservativeness bias of the central bank was not related to inflation significantly. The political independence of the central bank, however, appeared significant and negatively related to inflation. This seems to imply that conservativeness of the central bank per se does not secure moderate inflation. Granting political independence for the central bank seems to be decisive for moderate inflation rate. Inflation seemed to be negatively related to the degree of co-operation and positively to the power of the unions. A higher degree of co-operation seems to moderate inflation, as expected, while a larger power of unions leads higher inflation. Also the inflation targeting dummy appeared negatively related to inflation at 5.2% significance level. This seems to imply that countries that adopted inflation targeting were able achieve moderate inflation level faster than those following traditional approaches. Most likely this implies that the idea of substituting a lack of legal independence by full instrument independence was successful. All these results are, again, in line with theory, but they emphasise that moderate inflation rates are conditional not only on the legal independence of the central bank, but also on wage bargaining structure. The bottom line is, then, that it may not be sufficient to secure credibility of the central bank by granting legal independence for the central bank. Structural reforms in the wage bargaining practice may be necessary. Our results hint a need either to increase the co-operation in wage bargaining or decrease the power of the unions.

Indeed, the Lagrange Multiplier test statistic shows that omitting labour market variables from the regression leads into a mis-specified model. Moreover, the Wald test statistic for omitting the labour market variables rejects the hypothesis that labour market variables are insignificant (table 6).

Contrary to inflation model, and somewhat surprisingly, importance of the price objective in the status of the central bank had a significant negative effect on nominal wage growth in the model for wages. In addition, the personnel independence of the central bank has contributed to moderate wage growth, while the political independence variable was not significant. However, in contrast to the results on inflation, the inflation targeting dummy, when lagged one period, had a significant positive effect on nominal wage growth, while inflation targeting dummy without the lag was not significant. The difference between coverage and density rates and power of the unions had a marginally significant positive effect on wages.

It is important to note that nominal wage growth seemed to be very closely related to the central bank independence variables. The fact that the OBJE variable, which proxies the conservativeness of the central bank, was significant and negative strongly supports the argument that wage bargaining institutions and their beliefs on policymakers preferences play an important role in successful economic policy. The fact that personnel independence of the central bank was significant and negative, gives support for the credibility arguments, that granting legal independence of the central banks increases the credibility of the policymakers and therefore, leads into moderate inflation expectations.

The Lagrange Multiplier test statistic shows that even if the labour market variables were omitted from the regression the model specification was accepted. However, the Wald test statistic for omitting the labour market variables rejects the hypothesis that labour market variables are insignificant. This can be seen from Table 7. We also used a Wald test to test the Calmfors-Driffill hypothesis that the relationship between centralisation of wage bargaining and wage growth should be hump-shaped. Omitting the variable (C-D), which captured this hump-shaped relationship, was not rejected. However, when the wage growth model was estimated without the variables DICODE (the difference between coverage and density rates), omitting C-D was rejected at the 10% level.

When estimating the model for unemployment log standardised unemployment rates were used. Interestingly, we found that policy independence had a significant negative effect on unemployment. This result seems to be consistent with the finding that wage growth is negatively related to personnel independence. The degree of co-operation in wage bargaining was negatively related to unemployment. The difference between coverage and density rates had significant positive effect on unemployment, when the model was estimated without the quadratic term C-D, capturing the Calmfors-Driffill hypothesis. When the model was estimated with both variables, only the quadratic term C-D remained significant. This is due to the fact that these two variables are highly correlated.

The result that policy independence of the central bank leads to moderate inflation and personnel independence leads to both moderate wage growth and unemployment rate gives a strong support for the arguments of Cottarelli and Giannini (1997). Namely, it seems that establishing arrangements, which decrease the discretionary power of the government over the central bank but leaves

necessary flexibility for the monetary policy, is desirable. Moreover, because the co-ordination variable both contributes moderate inflation rates and unemployment rates, it seems likely that in the co-ordinated wage bargaining systems, this co-ordination has improved the credibility of the monetary policy.

Similarly with the wage growth equation, a Lagrange Multiplier test statistic shows that the model specification was accepted even without wage bargaining variables. The Wald test statistic for omitting the labour market variables, in turn, rejects the hypothesis that labour market variables are insignificant. This can be seen again from Table 7. The Wald test for Calmfors-Driffill hypothesis was marginally supportive. Omitting the variable (C-D), which captured this hump-shaped relationship, was rejected at 9% significance level.

Our results suggest that the wage bargaining structure and the central bank independence are related to dispersion of macroeconomic performance in OECD countries in rather complicated fashion. It seems evident that empirical studies, which have studied these two issues separately have neglected an important interaction of wage bargaining parties and monetary authorities. This is evident from the fact that we find much more significant results with respect to wage bargaining structure than for instance OECD (1997), which abstain from the central bank independence discussion. Our formal tests for this significance most strongly suggested that the estimated inflation model without labour market variables is misspecified.

In the particular case of Finland, the changes in the structure of the central bank involved in moving from the Bank of Finland as the decision-maker on monetary policy to the ECB are small in the short run, as the two structures were similar in practical terms at the changeover date at the end of 1998. However, our models cover a much longer period and the change between the ECB now and the Bank of Finland's independence over the period as a whole is somewhat larger. Given the relatively short lags in our model much of this change may have already passed through its benefit to unemployment. However, if we take just the interaction between the structure of wage bargaining and the independence of the ECB we could expect Finland to have below average unemployment levels, insofar as it has an advantage through the Calmfors-Driffill effect.

However, this paper has addressed the issues related to the average levels of inflation, nominal wage growth and unemployment only. The next step is to analyse, whether unemployment variability is related to these institutional variables.

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[1] This analysis forms part of a larger project supported by the UK ESRC under the One Europe or Several Programme, which considers the efficiency of various regimes in maintaining internal balance in the EU countries.

[2] See Mayes and Viren (1999) for a discussion.

[3] The real interest rate has in fact varied over the period and has affected other variables in the model, particularly unemployment, as also emphasised by Phelps and Zoega (1998) inter alia.

[4] Such a labour supply function can be derived from an underlying (static) constrained utility maximisation problem, as shown in Mayes and Vilmunen (1998).

[5] These non-modelled factors include preference shocks between consumption and leisure, changes in net immigration, changes in the birth and mortality rates, reservation wages and unemployment and other benefits.

[6] Terms of trade usually refers to the price of domestic exports relative to imports in domestic currency. Hence, it is the relative price associated with tradable goods. The real exchange rate, on the other hand, is often defined as the ratio of domestic and foreign price levels (in domestic currency). In the context of a single good small open economy of our model these two coincide. So we use 'terms of trade' in the main text to embrace both concepts.

[7] The literature on wage indexation (Gray, 1976; Fischer, 1977; Karni, 1983), especially in open economies (Turnovsky, 1983; Aizenmann and Frenkel, 1985a, b) under optimal wage indexing (Devereux, 1988; Vilmunen, 1992) provides a very useful theoretical background in this context.

[8] These non-modelled factors include (institutional etc.) parameters related to wage bargaining as well as various restrictions, such as minimum wage laws, on wage formation. Also, shocks to real interest rates could affect the stochastic behaviour of shocks to wage formation.

[9] I.e. the underlying IS-schedule is $y = -aq + u$ for some positive a, where u denotes exogenous IS or aggregate demand shocks, and include fiscal policy shocks, exogenous shocks to consumption and investment etc. Implicitly we are abstracting away from interest rate determination and simply take the real interest rate is as parametrically given.

[10] We could generalise (6) by letting $|\ |\leq 1$ and retaining the property that $_{V,t}$ is stationary. In this more general case, V_t is stationary, but not necessarily an AR(1) process, when $|\ | < 1$. On the other hand, when $|\ | = 1$, V_t is integrated of order 1, I(1), but not necessarily a pure random walk. The main reason for wanting flexibility in the stochastic structure of the shocks is that the cointegration implications of the model depend on the number of unit roots in the exogenous stochastic processes. For example, if shocks to wage formation are generated by a random walk and u_t I(1) and q_t I(1), then the trivariate system $X_t = (w_t, u_t, q_t)$ cannot be cointegrated (i.e. linear combinations X_t in the present context cannot be I(0)), whereas stationary, mean reverting shocks to wage formation imply cointegration among these variables. This implication of the wage shock is emphasised also by Jacobson *et al*. (1996 p. 6).

[11] There will be a unique solution, provided the determinant of the structural matrix linking the four endogenous variables together in the model structure is non-zero, see Jacobson *et al*. (1996) for an analogous condition (p. 5, where they denote the determinant by).

[12] A vector of constants is missing from (8), as we have abstracted from the relevant constants in developing the theory.

[13] Note that according to (9), long-run unemployment need not be independent of shocks to labour demand and supply. Lindbeck (1993) argues that a realistic macroeconomic theory should have long-run unemployment independent of productivity and labour supply shocks. This is very similar in spirit to the identification scheme used by Blanchard and Quah (1987) to identify aggregate demand and supply shocks, and is similar to what Blanchard and Katz (1996, p. 9) argue. Above, independence will prevail essentially if $_t$ - $_t$ is stationary, which, in the case of unit roots in labour demand and supply shocks, boils down to $_t$ and $_t$ sharing a common trend. Productivity, or a similar particular form of technological progress, would probably be the most plausible interpretation of this common trend, since shocks to productivity would affect not only labour demand, but also labour supply (see e.g. Blanchard and Katz, 1996, pp. 9-10).

[14] In general, it is difficult to choose the appropriate periodicity for the data. Quarterly data tend to have a high level of noise and short-run dynamics can obscure the more fundamental analysis we are concerned with here. Semi-annual data, however, are much more stable. Since both annual and semi-annual data provide similar outcomes we report the semi-annual results to minimise any loss of information.

[15] The argument that unemployment rate cannot have a unit root, because it is bounded by 0 and 1 - so that random labour market shocks would drive the unemployment rate to 0 or one with the passage of time (see e.g. Karanassou and Snower, 1997a, p. 4 fn. 11) - needs qualification. First of all, the unemployment rate cannot be an *unrestricted* (linear) random walk or Brownian motion because of the bounds. But it can be *regulated* Brownian motion (or even a Brownian bridge). Hence, there can be a unit root in the unemployment rate, but its fluctuations are constrained by barriers, most plausibly by reflecting barriers, since absorbing barriers would imply that the unemployment rate stays at a particular level, once it reaches that level. These barriers can e.g. reflect the internal workings of the economy itself or they can result from policy regulation. The existence of such barriers raises the possibility of a non-linear relationship between the unemployment rate and its fundamental determinants. Alternatively, there could be non-linearities in the process generating observed unemployment - e.g. regime shifts - so that observations on the unemployment rate look favourable to a unit root, in the context of unit root testing. At a general level, however, the unemployment rate is not much different from many other economic series, in the sense that these series cannot strictly speaking be modelled as (symmetric) unrestricted Brownian motion at least because of the existence of non-negativity constraints, which are typically ignored in the unit root tests of these series. Consumption, output, prices etc. are subject to non-negativity constraints and cannot thus be, strictly speaking, modelled as (symmetric) unrestricted Brownian motion. In these circumstances 'unit root econometrics' is implicitly assumed to give a reasonable basis for statistical inference in the context of (statistical) modelling these series. A similar line of reasoning is applied in the present context.

[16] The unit root test for the terms of trade is in line with (the extensive literature on) testing the validity of the PPP (purchasing power parity) in the sense that the test here suggests that deviations from the PPP are nonstationary (see Rogoff, 1995, for an excellent survey on PPP and long-run real exchange rates).

[17] The shape of the estimated spectrum for the growth rate of the capital stock also confirms that there is substantial autocorrelation in the series. The estimated spectrum for the growth of the real wages, on the other hand, is U-shaped, where the minimum occurs approximately at frequency 3/4, implying that cycles shorter than 1 1/3 years make a considerable contribution to the variance of the growth rate of real wages.

[18] Available from the authors upon request.

[19] We will return to the possible I(2) of the capital stock in the context of the cointegration analysis, where the growth rate of the capital stock is also used instead of the log-level. As far as the other diagnostics are concerned, we checked the outcome from the ADF test by including two impulse dummies in the test equation to mitigate the effects of the outliers around 1990. The t-statistics, t , did generally rise at various lags, even to the extent that at lags 3 and 4, the null of a unit root was rejected at the 5 % significance level. The 10 % critical value for the ADF test (from McKinnon, 1991), on the other hand, is around -3.1619, which tends to lend support for the rejection of a unit root in the growth rate of the capital stock, but does not, unfortunately, fully sustain the conclusion in the main text that the growth rate of the capital stock is (trend) stationary.

[20] A battery of specification tests was run on the ECM representation underlying the cointegration analysis. The ECM of the VAR(4) captures most of the observed variation in the growth rates of variables (i.e. x_t); no residual autocorrelation is left in the equations; a small ARCH-effect at lag 2 is present in the residuals for the growth rate of capital, but no more general form of heteroscedasticity can be detected from the residuals. The null of normal residuals, however, is rejected in the case of the growth rate of unemployment and capital stock. It appears from the graphs of the residuals that this stems mainly from skewness. The sample distribution of unemployment residuals appears to be slightly positively skewed due to the sharp increase in the observed unemployment rate in 1990-91. Residuals from the growth rate of the capital stock appear to be a mirror image of those of the unemployment rate; i.e. their sample distribution is skewed to the left.

[21] And hence involves all the parameters of the model.

[22] All the subsequent tests are conditional on r = 1, i.e. that the cointegration rank is one.

[23] This set up would correspond to our theoretical model with $_1 = _1 = 0$. Under this assumption, we can immediately see that wages do not respond to labour demand or technology and labour supply shocks, only to shocks to wage formation and terms of trade. Since the capital stock is driven by technology shocks and terms of trade by its own autonomous component and shocks to wage formation, the bulk of the adjustment falls on unemployment in the sense that it is affected by all sources of shocks.

[24] The standardised or reduced form vector is (1.000, -2.856, 1.151, 1.163) and the asymptotic S.E's are 0.2107, 1.4103, 0.8689 and 0.8409.

[25] See e.g. Parjanne (1997). With annual data, real wages appear to fall by 0.1 percentage points after a one percentage point increase in unemployment.

[26] In the context of a different model, Nickell (1997, p. 2) also emphasises the dependence of the model's parameters on the institutional features of the labour market.

[27] Yet another possibility for the non-responsiveness of real wages to unemployment variations may involve aspects from human capital development during unemployment spells. The average ability of unemployed workers falls during unemployment, which, among other things, tends to increase the mismatch between vacancies and unemployed workers. Hence, anything that reduces the effectiveness of the long-term unemployed as fillers of vacancies, such as long periods receiving benefit, will tend to lower the responsiveness (Nickell, 1997, p. 2).

[28] One factor that may sustain higher wage responsiveness in New Zealand is the benefit reform of 1991, which, through reduction of benefits, appears to have increased incentives to work and, hence labour market participation (Maloney 1997).

[29] Hansen and Hutchison (1997) find support for such an emphasis on real determinants of nominal exchange rates in New Zealand. Their model of the real side of the economy is different from ours.

[30] This literature builds on Bruno and Sachs (1985), Cameron (1984), Calmfors (1982,1985, 1988), Crouch (1985), Freeman (1988), Lindbeck and Snower (1989), Pohjola (1987) and Soskice (1990).

[31] See for instance Akhand(1992), Bleaney (1996), Cubit (1993), Skott (1995), Cukierman and Lippi(1998), Velasco and Guzzo (1998), Iversen (1998).

[32] Lawrence and Summers (1988), for instance.

[33] This correlation refers to year 1994.

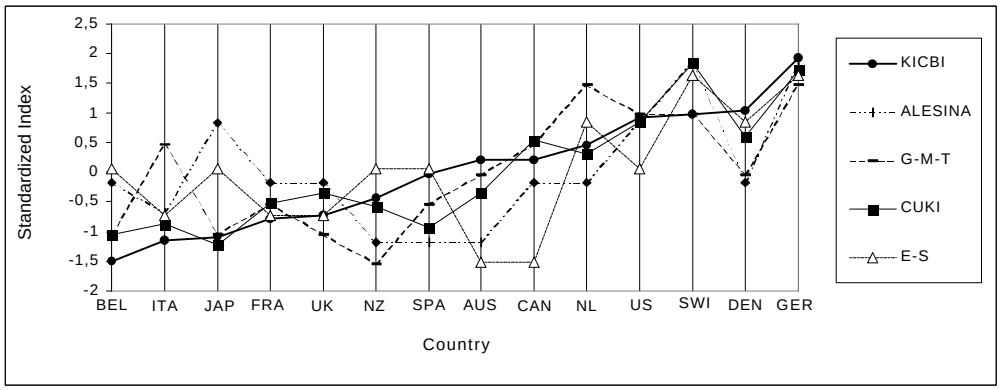
[34] Inclusion of the lagged dependent variable among the regressors results in some collinearity problem between lagged dependent variable and institutional variables. In order to assess seriousness of this problem we also estimated the basic model without lagged dependent variables but with an autocorrelation correction for the errors, as suggested by Park (1967). In this case we assumed that autocorrelation coefficient for each country was the same. In general, the model specification remained the same, but significance of the institutional effects increased.

Table 1. Inflation Targeting and Indices of Central Bank Independence

Index	Alesina	G-M-T	E-S	CUKI	KICBI
Country					
Australia	1	9,3	1	0.31	0.36
Austria	-	9,3	3	0.58	0.59
Belgium	2	7,1	3	0.19	0.07(0.34)
Canada	2	11,4	1	0.46	0.36
Denmark	2	8,3	4	0.47	0.50
Finland	2	-	3	0.27	0.28
France	2	7,2	2	0.28	0.19 (0.66)
Germany	4	13,6	5	0.66	0.65
Greece	-	4,2	-	0.51	0.54 (0.62)
Ireland	-	7,3	-	0.39	0.60
Italy	1.5	5,4	2	0.22	0.13 (0.33)[a]
Japan	3	6,1	3	0.16	0.14
Netherlands	2	10,6	4	0.42	0.40
New Zealand	1	3,0	3	0.27	0.25 (0.30)
Norway	2	-	2	0.14	0.15
Portugal	-	3,1	2		-
Spain	1	5,2	3	0.21	0.32 (0.64)
Sweden	2	-	2	0.27	0.26 (0.44)
Switzerland	4	12,5	5	0.68	0.49
The U.K.	2	6,1	2	0.31	0.20
U.S.	3	12,5	3	0.51	0.48

Notes: Alesina refers to Alesina (1993). G-M-T refers to Grilli, Masciandro, Tabellini (1991). The first figure is their index of economic independence and the second political independence. E-S refers to Eijffinger-Schaling (1995), CUKI refers to Cukierman (1992) and to an unweighted index of legal independence of the central banks (LVAU). Bold figures indicate the countries which adopted an explicit inflation targeting regime as existed at the end of 1996. The first 4 indices refer to the period of 1980-89. The first figure in the last column refers to 1980s and the last to 1996. a) The first figure in KICBI refers to the situation before the divorce between the Treasury and the Bank of Italy in 1981. Otherwise the first figure refers to 1985. If there is one figure only, there has not been a change in the statute of the central bank.

Figure 1. Comparison between the Legal Indices of the Central Banks



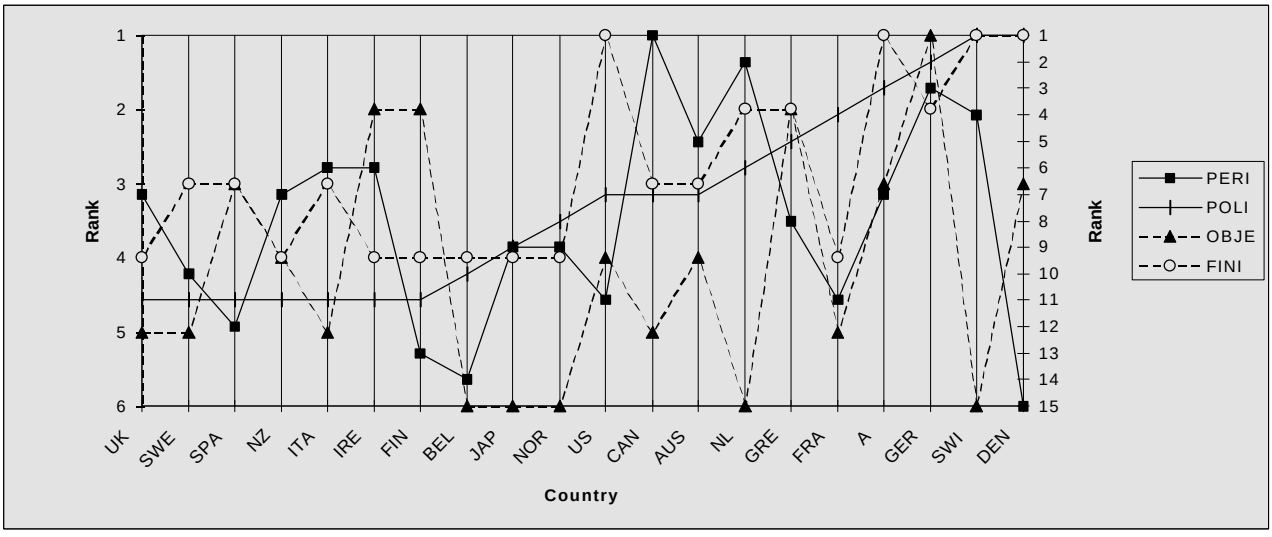
Notes: Indices refer to the period of 1980-1989. Austria, Finland, Norway, Sweden, Greece and Portugal were excluded from comparison because of lack of available data. Countries were ranked according to KICBI index from the least independent to the most independent. G-M-T refers to political independence of their index.

Table 2. Spearman Rank Correlations Between different indices

INDEX	Kicbi	E-S	ALESINA
CUKI	0.90	-	-
G-M-T	-	0.88	0.89
E-S	-	-	0.96

Notes: Spearman's rank correlation is calculated between those indices which were closely comparable. KICBI and CUKI ranked the countries with a larger scale, while ALESINA, G-M-T and E-S used the scale that was significantly smaller.

Figure 2. Comparison between Different Forms of Independence during 1980-1989 2.



Notes: Countries have been ranked according to policy independence (POLI) variable from the least independent to the most independent. Right hand side scale refers to the scale of PERI and POLI and left hand side to the scale of OBJE and FINI. The time period is 1980-1989.

Table 3. Spearman Rank Correlation between Different Forms of Legal Independence

INDEX	PERI	POLI	OBJE	FINI
PERI	1			
POLI	0.66 (0.65)	1		
OBJE	0.50 (0.48)	0.64 (0.72)	1	
FINI	0.38 (0.32)	0.05 (0.28)	0.93 (0.89)	1

Notes: Values in brackets refer to year 1996 and values without brackets to the period of 1980-1989.

Table 4. Centralisation and Co-ordination of Wage Bargaining in 1994

Country	Centralisation	Co-ordination
Australia	1.5	1.5
Austria	2+	3.0
Belgium	2+	2.0
Canada	1.0	1.0
Denmark	2.0	2+
Finland	2+	2+
France	2.0	2.0
Germany	2.0	3.0
Greece	-	-
Ireland	-	-
Italy	2.0	2.5
Japan	1.0	3.0
Netherlands	2.0	2.0
New Zealand	1.0	1.0
Norway	2+	2.5
Portugal	2.0	2.0
Spain	2.0	2.0
Sweden	2.0	2.0
Switzerland	2.0	2+
The U.K.	1.5	1.0
U.S.	1.0	1.0

Source: OECD (1997).

Notes: Centralisation and co-operation figures are based on OECD secretariat estimates of prominent bargaining level and the degree of co-ordination in 1994. Co-ordination includes both union and employer co-ordination. A value of 1 in each characteristic is assigned to the decentralised/uncoordinated system and a value of 3 for the centralised/co-ordinated wage bargaining system.

Table 5. Density and Coverage rates in OECD Countries in 1994

Country	Density	Coverage
Australia	.35	.80
Austria	.42	.98
Belgium	.54	.90
Canada	.38	.38
Denmark	.76	.69
Finland	.81	.95
France	.09	.95
Germany	.29	.92
Greece	-	-
Ireland	-	-
Italy	.39	.82
Japan	.24	.21
Netherlands	.26	.81
New Zealand	.30	.31
Norway	.58	.74
Portugal	.32	.71
Spain	.19	.78
Sweden	.91	.89
Switzerland	.27	.50
The U.K.	.34	.47
U.S.	.16	.18

Source: OECD (1997, Table 3.3, p. 71)}

Notes: a) These figures refer to 1994 except in the case of collective bargaining coverage in Canada (1993), Finland (1995) France (1995), Italy (1993), Japan (1995), Norway (1993), Portugal (1993) and in the case of union density in Denmark (1993), Finland (1995), Germany (1993), Italy (1992), the Netherlands (1993), Portugal (1990), Sweden (1993) and Switzerland (1992).

Table 6. Estimation Results

Variable	Δp	Δw	u
Δp		0.52 (0.151)	
Δw	0.30 (0.045)		
Δu	-0.03 (0.199)	-0.83 (0.221)	0.29 (0.056)
Δp(t-1)	0.44 (0.059)		
Δw(t-1)		0.42 (0.107)	
u(t-1)			0.92 (0.19)
Rw			-0.01 (0.007)
POLI	-2.05 (1.000)		-0.24 (0.106)
PERI		-1.78 (0.647)	-0.08 (0.033)
OBJE		-0.69 (0.363)	0.03 (0.025)
EITAR	-0.99 (0.505)	1.73 (0.642)	0.016 (0.046)
COOP	-0.76 (0.190)	-0.24 (0.250)	-0.04 (0.016)
CODE		1.95 (0.762)	0.05 (0.047)
MOPO	0.48 (0.163)	0.29 (0.307)	
C-D		-0.07 (0.418)	-0.05 (0.028)

Notes: Δp refers to inflation, Δw to nominal wage growth and u to standardised unemployment rate. Number of countries (N) is 17 and the time period runs from 1973-1996. Instrumental variable estimation was used with lagged dependent variables and growth rates as instruments. OBJE measures an importance of price stability in the status of the central bank. POLI measures political independence of the central bank. PERI measures personnel independence of the central bank. COOP measures a degree of co-operation of wage bargaining (See Table 2). Higher the index, higher the degree of co-operation. MOPO is constructed as MOPO=CENTRA*DENSITY and captures a monopoly power of unions and effect of unions to aggregate wages. EITAR is dummy for countries that adopted inflation targeting. C-D=(2-CENTRA) and captures the Calmfors-Driffill hypothesis of hump-shaped relationship between macroeconomic performance and a degree of centralisation of wage bargaining. CODE = COVERAGE - DENSITY. Rw is real wage growth. Values in brackets are panel-corrected standard errors (PCSE). See the main text for more detailed explanations.

Table 7. Hypothesis Testing

	Inflation equation	Wage equation	Unemployment equation
Missspecification test	LM , , = 2.62 (0.004)	LM , = 1.09(0.580)	LM , = 0.06(0.473)
Wald test for the significance of the labour market variables	χ^2 (2)=16.28(0.000)	χ^2 (3)=6.94(0.078)	χ^2 (4)=14.14(0.006)
Wald test for Calmfors-Driffill hypothesis	-	χ^2 (1)=0.04(0.833) χ^2 (2)=2.67(0.102)[a]	χ^2 (1)=2.80(0.094)

Notes: LM , refers to joint test for serial correlation and individual effects in the errors. See main text for more details. a) This refers to the case where the variable DICODE, the difference between coverage and density rates, was excluded from the model.

Appendix I

Unit root tests for the log of the unemployment rate *u*, log of the real consumption wage *w*, log of the capital stock *k* and log of the terms of trade *q*

Table I.1: ADF unit root tests for the levels u, w, k and q, 1992.1 - 1996.2
Asymptotic Critical Values; 5 % = **-3.476**, 1 % = **-4.097**; Constant and Trend included

Variable	**Lag**	**t-adf**	**Beta (t-1)**	**Sigma**	**t- (lag)**	**t-prob**	**F-prob**
U	4	-2.586	0.855	0.127	-0.581	0.563	
	3	-3.099	0.842	0.126	-0.859	0.394	0.563
	2	-3.962*	0.821	0.126	1.287	0.203	0.589
	1	-3.760*	0.847	0.127	6.922	0.000	0.446
W	4	-2.693	0.911	0.014	1.732	0.088	
	3	-2.441	0.919	0.014	-0.259	0.796	0.088
	2	-2.552	0.917	0.014	3.015	0.004	0.224
	1	-2.078	0.929	0.015	0.151	0.881	0.010
Q	4	-2.207	0.866	0.030	0.815	0.418	
	3	-2.071	0.879	0.030	1.689	0.096	0.418
	2	-1.705	0.902	0.031	-1.247	0.217	0.182
	1	-2.146	0.881	0.031	1.528	0.132	0.177
k	6	1.119	1.008	0.003	-1.180	0.243	
	5	0.918	1.006	0.003	-0.329	0.743	0.243
	4	0.874	1.006	0.003	-1.102	0.275	0.478
	3	0.584	1.004	0.003	-2.494	0.015	0.446
	2	-0.131	0.999	0.003	-0.185	0.854	0.078
	1	-0.209	0.998	0.003	11.910	0.000	0.130

Note: The test equation is $x_t =$ + t + $_1x_{t-1}$ + $_2x_{t-2}$ + ... + $_px_{t-p}$ or $x_t =$ + t + x_{t-1} + $_i$ x_{t-i} + $_t$, where we sum from 1 to p-1 and where = $_1$ + $_2$ + ... + $_p$ -1; t-adf = t-value on the lagged level, t ; Beta (t-1) = sum of the estimated AR-coefficient, $\hat{r}_1 + \hat{r}_2 + ... + \hat{r}_p$; sigma = standard error of regression; t- (lag) = t-value of the longest lag, t $_j$; t-prob = significance of the longest lag: 1 - P(| |≤ |t$_j$ | ; F-prob = significance level of the F-test on the lags dropped up to that point; * si g-nificant at 5 %.

Table I.2: ADF unit root tests for the first differences u, w, k and q 1962.2 - 1996.2
Asymptotic Critical values: 5%= **-2.904** 1%= **-3.528**; Constant included (and Trend for *CSTOCK*)

Variable	Lag	t-adf	Beta (t-1)	Sigma	t- (lag)	t-prob	F-prob
u	4	-4.643**	0.227	0.132	0.821	0.415	
	3	-4.980**	0.299	0.132	1.687	0.097	0.415
	2	-4.726**	0.421	0.134	2.447	0.017	0.182
	1	-3.916**	0.553	0.134	0.444	0.659	0.029
w	4	-2.825	0.423	0.015	0.837	0.406	
	3	-2.696	0.478	0.015	-1.715	0.091	0.406
	2	-3.752**	0.334	0.015	0.387	0.700	0.172
	1	-4.026**	0.365	0.015	-2.954	0.044	0.296
q	4	-3.165*	0.165	0.031	-0.345	0.731	
	3	-3.697**	0.126	0.031	-0.247	0.806	0.731
	2	-4.368*	0.098	0.031	-1.250	0.216	0.915
	1	-6.559**	-0.063	0.031	1.775	0.081	0.640
k	6	-2.452	0.781	0.003	-0.260	0.796	
	5	-2.870	0.771	0.003	0.985	0.329	0.796
Crit. Value;	4	-2.701	0.802	0.003	0.135	0.893	0.603
5 % = **-3.478**	3	-2.903	0.806	0.003	0.884	0.380	0.792
1 % = **-4.101**	2	-2.773	0.826	0.003	2.403	0.019	0.773
	1	-2.175	0.863	0.003	0.247	0.806	0.214

Note: See Table I.1

Appendix II

Cointegration analysis of the system consisting of the log of the unemployment rate *u*, log of the real consumption wage *w*, log of the capital stock *k* and log of the terms of trade *q*

Table II.1: Cointegration rank of the system 1962.2-1996.2

(a) Eigenvalues

Eigenvalue	Loglik. for rank	
	1096.50	0
0.3636	1112.09	1
0.1613	1118.16	2
0.1014	1121.85	3
0.0028	1121.94	4

(b) Test statistics

H0: rank=r	Max	T - 4k	CV 95%	Trace	T - nm	CV 95%
R = 0	31.18*	27.57*	27.1	50.89*	45.00	47.2
R 1	12.14	10.73	21.0	19.71	17.42	29.7
R 2	7.38	6.52	14.1	7.57	6.69	15.4
R 3	0.19	0.17	3.8	0.19	0.17	3.8

Notes; Max = maximal eigenvalue test for the rank; T-4k corrects the tests for small sample bias, i.e. uses T-4k instead of T; CV 95% = 95% Critical Value; Trace = trace test for the rank; T-nm corrects the test for small sample bias.

c) Standardised (eigenvectors)

u	w	k	q
1.000	**-3.322**	**1.526**	**1.626**
-0.032	1.000	-0.754	-0.878
0.470	-9.990	1.000	18.899
-0.158	-7.625	4.723	1.000

(d) Standardised -coefficients

u	-0.341
w	-0.011
k	-0.001
q	-0.027

Appendix III

Table III.1 Recent changes in Central Bank Laws

Country	Act	Main Changes	Code	Change
Belgium	93	The Government cannot oppose the decision taken by the CB relating to its key tasks Extension of credit by the CB for the government forbidden	mpo lla	0.0 → 1.0 0.0 → 1
France	93	The CB shall formulate and implement monetary policy with the aim of ensuring price stability The CB shall neither seek nor accept instructions from the government or any person Credit for the government forbidden	obj mpo lla	0.20 → 1.0 0.67 → 1.0 0.67 → 1.0
Greece	92	Credit for the government forbidden	lla	0.25 → 1.0
New Zealand	89	Primary objectives defined as economic objectives of achieving and maintaining stability in the general price level The bank has sole authority to implement monetary policy, but override provisions of the government exist Governor can be dismissed for poor performance	obj diss	0.40 → 0.80 0.83 → 0.17
Italy	92 93	Governor sets the official discount rate Credit for the government forbidden	int lla	0.25→ 1.0 0.33 → 1.0
Spain	94	Primary objective price stability but supports the general policy of the government if that does not conflict with price stability Term of office of the governor extended to 6 years No instructions from the government in implementation of monetary policy Dismissal of governor restricted to non-policy reasons only Credit to the public sector prohibited	obj too mpo diss lla	0.6 → 0.6 0.25 → 0.75 0.33 → 1.0 0.0 → 0.83 0.33 → 1.0
Sweden	88	Term of office of the Governor extended into 5 years Credit for the government forbidden	too lla	0.0 → 0.25 0.0 → 1.0

Sources: Cukierman (1992), Cottarelli and Giannini (1997, Table 7, p. 18) and various central bank laws.
Notes: Change of coding is based on own judgement of the central bank laws according to the main changes introduced. Changes are then translated into numerical values following the coding in Cukierman (1992).