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by

Steinar Holden

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Monetary regime and the co-ordination of wage setting

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Abstract

International comparisons show that countries with co-ordinated wage setting generally have lower unemployment than countries with less co-ordinated wage setting. This paper argues that the monetary regime may affect whether co-ordination among many wage setters is feasible. A strict monetary regime, like a country-specific inflation target, to some extent disciplines wage setters, so that the consequences of uncoordinated wage setting are less detrimental than under a more passive monetary regime (eg a monetary union). Thus, the gains from co-ordination are larger under a passive regime. Under some circumstances a passive regime may induce co-operation in wage setting, and thus lower unemployment, when a stricter regime would not.

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1 Introduction

Over the last decades, explanations of the high European unemployment have increasingly focused on the structure of the labour market. The wage formation system has played a key role in many of the explanations. An important view, advocated by among others Layard, Nickell and Jackman (1991), is that strong unions per se have a negative impact on employment, by increasing wage pressure. Yet if wage setters co-ordinate their wage setting, taking into consideration the negative external effects identified in the literature (cf. surveys in Moene, Wallerstein and Hoel, 1993, and Calmfors, 1993), the negative impact of unions may be mitigated. Indeed, the findings of several international comparisons (e.g. Nickell, 1997, OECD, 1997) support the theoretical prediction, showing a marked tendency that countries with a high degree of co-ordination in the wage setting have lower unemployment. More recently, Blanchard and Wolfers (1999) show that co-ordination in wage setting is one factor that explains whether adverse economic shocks have persistent effects on unemployment.

Given the large potential benefits of co-ordination in wage setting, suggested by theory and supported by empirical evidence, a crucial question is: Why are unions in some countries able to co-ordinate their wage setting, while unions in other countries are not? This issue has, however, not received much attention within the economics literature (two exceptions are Holden and Raaum, 1991, and Holden, 1991a). As observed by Flanagan (1999), most studies take the labour market institutions as exogenous. To some extent this contrasts the political science literature, where this issue has been discussed considerably, cf. Iversen (1999) and the references therein.

The present paper argues that the monetary regime may be one factor that affects whether co-ordination of wage setting is feasible. The argument builds on a recent literature, including Bratsiotis and Martin (1999), Soskice and Iversen (1998, 1999) and Coricelli,

Cukierman and Dalmazzo (2000),[1], where it is shown that a non-accommodating central bank disciplines large wage setters by making employment more sensitive to the real wage. In the present paper, the result of this literature is blended with the analysis of Holden and Raaum (1991) and Holden (1991a) on whether co-ordinated wage restraint is feasible. Somewhat simplified, the idea is as follows. Consider an economy with several large wage setters (e.g. industry unions), where uncoordinated wage setting will lead to an adverse outcome with high unemployment. Unions have an incentive to co-ordinate their wage setting to achieve wage restraint. However, a binding agreement is not possible, so any union may deviate from the co-ordination and obtain higher wages. The deviator will obtain a gain in the short run, but at the expense of a possible breakdown of the mutually beneficial co-ordination on wage restraint. Co-ordination is only sustainable if unions' discount factor is sufficiently high so that the long run costs of a breakdown of the co-ordination outweigh the potential short run gain from deviating.

Now enter the effect of the monetary regime. If unions co-ordinate their wage setting, the effect of the monetary regime is small, because a good equilibrium, with low unemployment, can be achieved in any case. In contrast, if wage setting is unionised, but uncoordinated, the monetary regime is more important, because a strict central bank may discipline wage setters and thereby dampen the negative consequences of uncoordinated wage setting.[2] Thus, the gains from co-ordination of wage setting are larger if the central bank is accommodating, providing unions with a greater incentive to co-ordinate. This implies that

[1] See also Horn and Persson (1988), Holden (1999), Wibaut (1999), and Vartiainen (1999). In a related literature, Cubitt (1992, 1995), Skott (1997), Jensen (1997), Gruner and Hefeker (1999), Cukierman and Lippi (1999a,b), Guzzo and Velasco (1999), and others argue, that unions are also concerned about inflation. Under this assumption an accommodating central bank may induce wage moderation and lower unemployment by "exploiting" that unions do not want to cause inflation.

[2] This distinction is made clear in Bratsiotis and Martin (1999), but without any remarks on the possible implications for whether co-operation is feasible.

for some levels of unions' discount factor, co-ordinated wage restraint is only feasible if the central bank is accommodating.

The idea that large unions' confederations may strive to restrain wages, but that they do not always succeed, may seem strange to many economists. However, this view is not only consistent with the theories and evidence mentioned above, it is also consistent with the rhetoric of trade union leaders in several European countries. In countries like the Netherlands, Denmark and Norway, leaders of trade unions' confederations talk publicly about the merits of co-ordinated wage restraint. Occasionally, unions' confederations even make explicit agreements with employers and the government with the intention of restraining wages (some examples are: the Wassenaar agreement in the Netherlands in 1982; the Solidarity alternative in Norway 1992; several agreements in Ireland in the 1980s and 90s). However, union leaders may find it difficult to persuade the rank and file, and sometimes they do not succeed in their wage restraint.

The analysis of the present paper also sheds light on the consequences of participation in a monetary union. As argued by Soskice and Iversen (1998) and Cukierman and Lippi (1999b), monetary policy will not have the same disciplining effect on wage setting in a monetary union as in a country with a country-specific inflation target. The reason is that even if the central bank in the monetary union is a vigorous inflation fighter, the monetary policy response to higher wages in a single country would be small, because the effect on the aggregate price level in the union of higher wages in one single country would be small. In contrast, in a country with a country-specific inflation target, the central bank would counteract the effects of higher wages by increasing the interest rate. Thus, Soskice and Iversen (1998) and Cukierman and Lippi (1999b) argue unions will be more reluctant to increase wages under a country-specific inflation target, so that a monetary union will involve higher real wages and higher equilibrium unemployment. However, in this argument the

degree of co-ordination in wage setting is taken as exogenous. If one takes into consideration that the monetary regime may affect the degree of co-ordination, the conclusion may be reversed. Precisely because EMU may involve higher unemployment, the incentives for unions to co-ordinate wage setting at the national level are higher in the EMU. The analysis of the present paper implies that under some circumstances, co-ordination of wage setting would not be possible under a country-specific inflation target, but it would be possible under membership in the EMU. Thus, under these circumstances membership in the EMU would lead to lower equilibrium unemployment.

To focus sharply on the effect of the monetary regime on whether co-operation in wage setting is sustainable, the model is kept simple on other accounts. There are no shocks in the model, so stabilisation issues are neglected. Other possible effects of participation in a monetary union, like increased product market competition, or a change in the incentives for labour market reform (Bean, 1998, and Calmfors, 1998), are also neglected.

The paper is organised as follows. In section 2, I present the basic economic model, adapted from Bratsiotis and Martin (1999). In section 3, I analyse whether co-ordination in wage setting is feasible, drawing upon the theoretical framework in Holden and Raaum (1991). In section 4, I explore whether the key empirical prediction is consistent with data. Section 5 concludes the paper.

2 The model

We consider an economy consisting of n symmetric firms. The workers are organised in $k < n$ symmetric unions, so that each union covers n/k firms. Note that the assumption that the economy is symmetric and completely unionised is not important, but mainly done to simplify the analysis. The aim is to capture two important elements of European labour markets: (i) There are several fairly large wage setters (typically industry unions). (ii) Most wage earners

have their wage set by these large wage setters (bargaining coverage in Western European countries was in 1994 in the interval from 70 to 98 per cent, with two exceptions, UK 47 per cent and Switzerland 50 per cent, see OECD, 1997, table 3.3).

In the model, time horizon is infinite. We first consider behaviour in one time period, which I shall to refer to as a year. To save on notation, time subscript is suppressed whenever possible. Firms produce under diminishing returns to scale, with labour as the only input

$$(1) \qquad y_i = \gamma l_i \qquad\qquad 0 < \gamma < 1$$

where lower case denotes natural logarithm, y is production, l is labour, γ is the elasticity of output with respect to labour, and subscript indicates firm. Firms set the price of their product facing a downward sloping demand curve[3]

$$(2) \qquad y_i = \bar{g} + a(m - p) - \eta(p_i - p) \qquad\qquad \alpha, \eta > 0$$

where $\bar{g}$ is a constant, m is the nominal money stock, p is the aggregate price level defined as

$$(3) \qquad p = \frac{1}{n}\sum_{i=1}^{n} p_i$$

Unions care about the real wages and the employment of their members. The annual loss function of union j is

[3] As shown by Weitzman (1985), this demand curve can be derived from optimising household behaviour.

(4) $$\Omega_j = \frac{1}{2}(w_j - p - \omega^*)^2 + \frac{\theta}{2}(l_j - l_f{}^*)^2$$

where j indexes the union, ω^* and $l_f^* = l^*/k$ are the target levels of real wages and employment (identical across firms), l^* is the total labour force, and $\theta > 0$ denotes the union's relative concern for employment. The targets are assumed to take values so that it is not possible to achieve both targets simultaneously. This will ensure that in optimum, unions set a money wage so that both the real wage and the employment level are below their target values (cf. simulations below), and union loss will be decreasing in both real wages and employment.

The central bank sets the nominal money stock according to a predetermined rule

(5) $$m = \overline{m} + \rho(p - p^*)$$

where $\overline{m}$ is an exogenous component of the money supply, and ρ is the rate of accommodation of price deviations from the target level p^*. Note that ρ need not be positive, a central bank that is a vigorous inflation fighter would have a negative ρ. Within the present framework with no uncertainty, the only effect of letting the money stock depend on the price level is the strategic effect on wage and price setting. It is not necessary to realise the price target, because as the central bank can anticipate the equilibrium behaviour of the unions and firms, it can always realise its price target by setting $\overline{m}$ to the appropriate value prior to the game starts (that is, prior to the wage setting of the unions).[4] However, if the model was extended to include shocks, as in Bratsiotis and Martin (1999), it would be necessary for the

[4] This is perhaps most easily seen in the case where $\rho = 0$. In this case the classical dichotomy holds and the price level is uniquely determined by the exogenous money supply $\overline{m}$.

central bank to respond to these shocks. In this case (5) may be interpreted as the reduced form of a monetary rule where the central bank also responds to deviations of output from its equilibrium value, cf. Bratsiotis and Martin (1999).

Within the year, the sequence of events is as follows. First, the unions set the nominal wages (to simplify the analysis, I follow Bratsiotis and Martin and adopt the monopoly union assumption). Second, firms set prices so as to maximise their profits, employment and output being determined by (1) and (2). Third, the central bank sets the nominal money stock according to the monetary rule (5). All agents have complete knowledge of the model, and are able to perfectly forecast the behaviour of the other agents.

The price setting

Firms set the prices simultaneously. The first order condition for profit maximisation can be written as the following mark-up pricing rule

$$(6) \qquad p_i = \mu_i + w_i - \ln(\gamma) + (1-\gamma) l_i \qquad \text{where } \mu_i = \ln\left(\frac{\varepsilon_i}{\varepsilon_i - 1}\right)$$

where μ_i is the mark-up of price over marginal costs and $\varepsilon_i = -dy_i/dp_i$ is the price elasticity of demand, given by

$$(7) \qquad \varepsilon_i = -\frac{\partial y_i}{\partial p_i} - \frac{\partial y_i}{\partial p}\frac{\partial p}{\partial p_i} - \frac{\partial y_i}{\partial m}\frac{\partial m}{\partial p}\frac{\partial p}{\partial p_i}$$

Using (2), (3) and (5), (7) can be rewritten as

(8) $$\varepsilon = \eta - \frac{\eta}{n} + \frac{\alpha(1-\rho)}{n}$$

(8) shows that the total price elasticity consists of three components; the direct price elasticity η, the mitigating effect on the increase in relative prices by the rise in the aggregate price level, and the effect on the nominal money supply. Note that the degree of monetary

accommodation ρ affects the price elasticity, but that this effect is negligible if there is a large number of firms.

The first order conditions (6) for each firm jointly determine a Nash equilibrium in the price setting game among the firms. Aggregating across firms, we obtain the feasible real wage as given by the price setting (the price curve):

(9) $$\omega \equiv w - p = -\mu + \ln(\gamma) - (1-\gamma)l^* + (1-\gamma)u$$

where u is the rate of unemployment (using the approximation $u \approx l^* - l$).

Wage setting

We first consider the wage setting under the assumption that it takes place simultaneously by all unions, and without any co-ordination. Thus, when setting wages, unions know that they cannot affect the nominal wages of other unions (but they can predict the equilibrium wages), but they do take into consideration that the price and employment levels depend on the wages that are chosen. The first order condition of union j is

(10) $$\frac{d\Omega_j}{dw_j} = (w_j - p - \omega)\left(1 - \frac{dp}{dw_j}\right) - \theta(l_j - l_j^*)\frac{dl_j}{dw_j} = 0$$

The first order conditions (10) for each union jointly determine a Nash equilibrium in the wage setting game among the firms. From (3) and (6), we obtain

(11) $$\frac{dp}{dw_j} = \sigma(1 - (1-\gamma)\lambda), \qquad where \;\; \lambda = -\frac{dl_j}{dw_j}$$

where σ is an indicator of the centralisation of the wage setting, measuring the share of all workers in the economy that are represented by each wage setter. In the case with uncoordinated wage setting, σ = 1/k. The elasticity of the labour demand is (cf. appendix)

(12) $$\lambda = \frac{\alpha\sigma(1-\rho)}{\gamma + (1-\gamma)\alpha(1-\rho)} + \frac{\eta(1-\sigma)}{\gamma + \eta(1-\gamma)}$$

The two components of the elasticity of labour demand reflect the two channels through which a wage rise affects employment. The first channel is that wage rises lead to higher prices, reducing aggregate demand via a reduction in the real money stock. This effect is stronger the more centralised the wage setting (σ large), and the less accommodating the central bank (ρ small). The second channel is that a wage increase raises the relative price of the firms covered by the union, so that these firms obtain a smaller share of aggregate demand. This effect is stronger the more decentralised the wage setting (σ small), and the higher the price elasticity of product demand (η large).

By substituting out for (11) and (12) in (10), and aggregating over industries, we derive the wage curve:

$$(13) \qquad \omega \equiv w - p = \omega^{*} - \frac{\theta\lambda}{1-\sigma\left(1-(1-\gamma)\lambda\right)}u$$

Inspection of (13) and (12) shows that the degree of accommodation by the central bank, as measured by ρ, affects the real wage that unions aim at. A strict central bank, ρ small, makes labour demand more elastic (λ large), which induces the union to aim for a lower real wage (for given rate of unemployment); the wage curve in Figure 1 shifts downwards. The reason is that a strict central bank makes a real wage increase more expensive in the form of lost employment, thus all unions shift their choice in favour of wage moderation (as previously shown by Bratsiotis and Martin, 1999, and Soskice and Iversen, 1998,1999).

Equilibrium unemployment

The equilibrium rate of unemployment is given by the intersection of the price curve and the wage curve, cf. Figure 1. Algebraically, the equilibrium rate of unemployment is derived by combining the price curve (9) and the wage curve (13). The following Proposition is immediate.

Proposition 1: The equilibrium rate of unemployment is given by

$$(14) \qquad u^{*} = \frac{\omega^{*} + \mu - \ln(\gamma) + (1-\gamma)l^{*}}{(1-\gamma) + \dfrac{\theta\lambda}{1-\sigma\left(1-(1-\gamma)\lambda\right)}}$$

u^* is decreasing in θ and λ, and increasing in ρ, μ and ω^*.

Thus, the equilibrium rate of unemployment is decreasing in union preferences for employment, θ, and in the elasticity for labour demand, λ. It is via the latter variable that the monetary rule affects equilibrium unemployment; a strict central bank (ρ small and thus λ large) leads to a lower equilibrium rate of unemployment. Equilibrium unemployment is increasing in the target real wage of the unions, ω^*, and in the mark-up of price over marginal costs, μ. So far, the analysis and results follow Bratsiotis and Martin (1999).

Co-ordination in wage setting

As shown in the surveys of Moene et al (1993) and Calmfors (1993), wage setting by one group of workers involves a number of external effects on the welfare of other workers. In the present model, three of these are incorporated. Higher wages for the workers in one union lead to higher prices of the associated firms, which lead to (i) higher aggregate prices, reducing the purchasing power of other workers; (ii) higher aggregate prices, reducing aggregate demand via a reduction in the real money stock, with a negative impact on labour demand in other firms; (iii) lower relative prices for other firms, with a positive impact on labour demand in other firms. As the first two effects are negative, while the third is positive, the total effect is ambiguous from a theoretical perspective. Thus, the effect of the degree of centralisation, σ, on the equilibrium rate of unemployment as given by (14) is also ambiguous, when one takes into account that the elasticity of labour demand, λ, depends on σ. However, for reasonable parameter values, the two former negative external effects dominate, so that equilibrium unemployment is decreasing in centralisation, σ (cf. simulations below). As mentioned in the Introduction, unemployment being decreasing in centralisation is also

consistent with international comparisons and the rhetoric of trade union leaders. In the following, I shall assume that this is the case. Thus, if unions were to co-ordinate their wage setting, they would choose lower wages than they do when wage setting is uncoordinated.

If wage setting is uncoordinated, the real wage and unemployment outcome are derived by inserting $\sigma^N = 1/k$ in (12) to derive λ^N, and then λ^N and σ^N are inserted in (14) to derive the equilibrium rate of unemployment u^N. The associated equilibrium real wage, $\omega^N = w^N - p^N$, is given from the wage curve (13) (substituting out for the equilibrium rate of unemployment u^N from (14)). Union loss, denoted Ω^N, is derived by substituting out for the equilibrium real wage (13) and the equilibrium rate of unemployment (14) in (4)).

The outcome if unions co-ordinate their wage setting, setting the wage that minimises their loss, can be derived in the same way, employing that, under complete co-ordination, $\sigma^C = 1$. The loss under co-operation, Ω^C, is obviously smaller than the loss associated with uncoordinated wage setting, Ω^N. From the discussion above, unemployment and real wages are lower under co-ordination than under uncoordinated wage setting, i.e. $u^C < u^N$, and $\omega^C < \omega^N$. However, co-operation being desirable is not sufficient to ensure that it is accomplished, and this is the topic of the next section.

3 Is co-ordination of wage setting feasible?

One possible way of ensuring co-operation would be if the unions could sign a binding agreement on their wage setting. This, however, does not seem very realistic; a possible reason is the legal difficulties that would be involved, in view of the fact that collective agreements in reality are much more complicated than what is captured by the single wage

rate in the present model.[5] Another solution would be joint wage setting, i.e. that all unions bargain collectively with the employers. To some extent this does occur. For example, in Norway, all industry unions in LO occasionally bargain jointly. However, while economy-wide, joint negotiations might solve the co-ordination problem, it would also involve many additional complexities. One problem might be that the industry unions have different views on other issues than wages, for instance regulation of part time work, manning ratios, flexible working hours etc, that might be easier to solve in separate negotiations. A second problem is that there is usually some scope for wage increases after the wage settlements (wage drift), and the scope for wage drift varies among the unions. Thus not even joint negotiations would solve all co-ordination problems. A third problem is that joint negotiations might affect relative wages; there appears to be a robust empirical regularity that joint wage setting reduces wage dispersion, cf. Wallerstein (1999). Thus, high wage industries may not want joint wage negotiations.

A third solution, suggested by Soskice and Iversen (1998), is that one union acts as a wage leader vis-à-vis the rest of the labour market. However, as will be further discussed in section 4 below, this solution begs the question of why other unions will follow the leader. In the formal model, I shall neglect all these alternative solutions, and consider whether co-operation can be accomplished when each union always have the option of deviating from the co-operative solution.

As wage determination takes place simultaneously in all industries, any one union can deviate from the co-operative agreement and set a higher wage. This will not be discovered until the other unions have set their wage. Thus, if the wage setting in one year is viewed in isolation, an agreement among the unions that they will all set the lower wage associated with

[5] However, on rare occasions, e.g. in Norway in 1988-89, unions may accept legal restrictions on wage and price growth imposed by the government.

the co-operative equilibrium will not be credible. Each union prefers a higher wage for itself irrespective of the wage set by the other unions. Thus a prior agreement on wage moderation among the unions does not affect the fact that the unique one-shot Nash equilibrium in the wage setting game among the unions is the uncoordinated equilibrium derived above. All unions set the wage specified in (13) above, in the correct anticipation that the other unions will to the same.

However, the main issue of the present section is that unions are also concerned about the future consequences of their behaviour. To analyse this, we must specify the overall objective of a representative union j, which is to minimise the discounted sum of annual losses

$$(15) \qquad \sum_{t=0}^{\infty} \delta^t \Omega_{jt} \qquad \text{where } \delta = \frac{1-q}{1+\beta}, \quad 0 < \delta, q, \beta < 1$$

The discount factor δ consists of two elements. The pure rate of time preference, as measured by the discount factor *1/(1+β)*, and the probability that the game ends, and a new game starts, q . The start of a new game may be associated with the replacement of the leaders of the unions, or that an important exogenous event takes place that makes the unions re-consider any agreement on wage moderation, and if necessary resume a co-operative solution after a breakdown (cf. discussion below).

The game can now be analysed as a repeated game, where the annual wage setting is repeated over an infinite horizon of years (subject to the exogenous probability that the game ends, and a new game starts). The assumption that the horizon is infinite is the appropriate in this setting, because the notion that there exists a final period, where unions can neglect the future consequences of their behaviour, seems implausible in this setting (cf. Osborne and Rubinstein, 1990, page 54).

To derive the equilibrium of the game, it is convenient to define some further notation. Let $\Omega^D(\rho) = \Omega(w^D(\rho); w^C(\rho), \rho)$ denote the annual loss of a deviating union that sets $w^D(\rho) > w^C(\rho)$, while all other unions set the wage that minimises their joint loss, $w^C(\rho)$, and the rate of monetary accommodation takes the value ρ. (w^D is to be thought of as the optimal deviation. I shall not derive w^D explicitly, as this is not necessary for our purposes.) As observed above the annual loss of the unions is $\Omega^N(\rho) = \Omega(w^N(\rho); w^N(\rho), \rho)$ under uncoordinated wage setting, and $\Omega^C(\rho) = \Omega(w^C(\rho); w^C(\rho),\rho)$ under the co-operative agreement. From the discussion above, it is clear that $\Omega^D(\rho) < \Omega^C(\rho) < \Omega^N(\rho)$.

Consider now the following strategy for the unions:

1. Co-operate by setting $w^C(\rho)$ until some union alone deviates from co-operation.
2. If some union alone has ever deviated from co-operation, then never co-operate (that is, set $w^N(\rho)$) until a new game starts.

Thus, if one of the unions deviates from the agreement, all unions revert to the one-shot Nash equilibrium (this is the standard trigger strategy, cf. Friedman, 1986). This strategy will support a subgame perfect equilibrium if unions incur a higher (or equal) discounted total loss by deviating from the agreement, inducing a reversion to the uncoordinated one-shot Nash equilibrium, than by sticking to the agreement. This condition is equivalent to

$$(16) \qquad \frac{\Omega^D(\rho)-\Omega^C(\rho)}{\Omega^C(\rho)-\Omega^N(\rho)} \leq \frac{\delta}{1-\delta}$$

The numerator on the left hand side of (16) indicates the reduced loss of a deviation in the year of deviation, while the denominator indicates the higher annual loss in subsequent years.

The expression on the right hand side reflects that the gain of a deviation is immediate, but only once, whereas the subsequent loss is delayed, but may go on for a long time. Let $\delta^*(\rho)$ denote the value of the discount factor for which (16) holds with equality. The following Proposition is immediate from the analysis of trigger strategy equilibria (cf. Friedman, 1986).

Proposition 2: There exists a unique critical value $\delta^*(\rho) \in (0,1)$ such that co-operation is sustainable as a subgame perfect equilibrium under the strategy defined above if and only if $\delta \geq \delta^*(\rho)$.

Thus, the critical value for the discount factor depends on the degree of monetary accommodation, ρ. Both the temptation to deviate, as measured by the numerator of the right hand side of (16), and the subsequent costs associated with a breakdown of co-operative wage moderation, depend on ρ. A number of effects are present. First, ρ affects wage setting in symmetric equilibrium: a lower value of ρ (stricter central bank) leads to lower wages and lower unemployment, raising union welfare. Thus, a lower value of ρ mitigates the detrimental effect of uncoordinated wage setting. Secondly, ρ affects the gain from a deviation, via three channels. A lower value of ρ increases λ, which implies that (i) a wage rise has stronger negative effect on employment (this reduces the gain from a deviation), (ii) a wage rise has smaller impact on aggregate prices (this increases the gain from a deviation). (iii) A lower value of ρ reduces real wages and unemployment under co-ordination, so that the real wage is farther from its target value, while unemployment is closer to its target value. This increases the gain from a deviation. Thirdly, ρ affects price setting: a lower value of ρ reduces the mark-up by increasing the price elasticity. This is advantageous for the unions irrespective of the degree of co-ordination.

Despite its simplifying assumptions, the solution of the model is fairly complex, and I have been unable to sign the total effect unambiguously analytically.

The numerical simulations in Table 1 illustrate the properties of the model. Because of the highly stylised nature of the model, the magnitudes of the differences cannot be taken seriously. Yet the simulations provide a rough indication of the effects that are at work. The main results are apparent from the three columns to the left of the Table, which presents the equilibria for three different degrees of monetary strictness ρ.

- Vertical comparisons within each column shows that co-ordination leads to lower unemployment, lower real wages, and lower union loss than does uncoordinated wage setting. The effect is large: as indicated by the left column ($\rho = 0.5$), unemployment under co-ordination, u^C, is 4 percent compared to 19 percent under uncoordinated wage setting, u^N.
- Horizontal comparison shows that a stricter central bank (lower ρ), leads to lower unemployment, lower real wages, and lower union loss, if the degree of co-ordination is kept constant. The effect is small under co-ordination: E.g. $u^C = 0.0425$ for $\rho = 0.5$ and $u^C = 0.0423$ for $\rho = 0$. The difference is, however, somewhat larger under uncoordinated wage setting, e.g. $u^N = 0.191$ for $\rho = 0.5$ and $u^N = 0.177$ for $\rho = 0$.
- The bottom row shows that the critical value of the discount factor, δ^*, above which co-ordination is sustainable as a subgame perfect equilibrium, is decreasing in ρ. This is the main result of the paper. As an illustration, in the base case, if δ is in the interval between 0.144 and 0.165, co-ordinated wage restraint is sustainable if $\rho = 0.5$, but not if $\rho = 0$. (If δ is below 0.144, co-ordinated wage restraint is sustainable for both values of ρ, if δ is above 0.165, it is sustainable for neither.) This reflects that the gain from co-ordination is

greater for a higher value of ρ (the difference between Ω^C and Ω^N is greater for higher values of ρ).

- The eight columns to the right in Table 1 show that the qualitative results are not sensitive to the specific parameter values. Additional simulations with other variations of the parameter values (not reported) always give the same qualitative picture.

	Basis	Basis	Basis	α=0.5	α=0.5	n=10	n=10	σ^N= 0.05	σ^N= 0.05	η=3	η=3
	ρ=0.5	ρ=0	ρ=-0.5	ρ=0.5	ρ=0	ρ=0.5	ρ=0	ρ=0.5	ρ=0	ρ=0.5	ρ=0
u^C	0.0425	0.0423	0.0421	0.0427	0.0425	0.0467	0.0443	0.0425	0.0423	0.0216	0.0215
u^N	0.191	0.177	0.167	0.199	0.191	0.209	0.186	0.198	0.194	0.062	0.061
Ω^C	1.010	1.001	0.991	1.015	1.010	1.220	1.094	1.010	1.001	0.260	0.259
Ω^N	1.065	1.046	1.030	10.077	1.065	1.286	1.144	1.071	1.058	0.264	0.263
ω^C	-1.418	-1.411	-1.405	-1.422	-1.418	-1.558	-1.476	-1.418	-1.411	-0.719	-0.718
ω^N	-1.396	-1.391	-1.386	-1.398	-1.396	-1.534	-1.455	-1.395	-1.389	-0.713	-0.712
δ^*	0.144	0.165	0.184	0.132	0.144	0.132	0.159	0.150	0.156	0.099	0.102

Table 1: Numerical simulations in Gauss. Unemployment (u), union loss (Ω), and the real wage (ω) under uncoordinated (N) and co-ordinated (C) wage setting, for different values of the degree of monetary accommodation, ρ. δ^* is the critical value of δ that yields equality in equation (16). δ^* is calculated based on the approximation that the numerator in (16) is approximated by $\frac{\partial \Omega_j(w^C; w^C, \rho)}{\partial w_j}\Delta$, where Δ=0.01, except in the simulations with η=3, where Δ=0.001.[6] The top row indicates difference from base model. The second row indicates degree of monetary accommodation ρ. The base model has the following parameter values: α=1, γ=0.85, σ^C=1, σ^N=0.2, n=100, η=1.5, ω^*=0.

Thus, the simulations indicate that under a strict central bank, unions must be more far-sighted for co-ordinated wage restraint to be sustainable, than if the central bank is accommodating. A main reason is that the consequences of uncoordinated wage setting are more detrimental if the central bank is accommodating. One implication is that the relationship between equilibrium unemployment and central bank strictness may be non-

[6] Note that the optimal deviation is not w^N, because if a union were to deviate from an equilibrium it would be the only deviator, so other unions would not set w^N to which w^N is the best reply.

monotonic. For a given degree of co-ordination in wage setting, a more accommodating monetary regime is likely to lead to higher unemployment. However, at some point a more accommodating regime may induce co-ordinated wage restraint, leading to much lower equilibrium unemployment.

Discussion

Proposition 2 and the numerical simulations should not be taken to imply that the monetary regime is the only, or even the most important, factor that determine whether co-ordination of wage setting is feasible. Holden and Raaum (1991) explore this question more generally, within a similar theoretical framework, and conclude that co-ordinated wage restraint is easier to achieve if, among other things, union density (and coverage) is high (because the consequences of uncoordinated wage setting are worse), and if the political climate is stable (because co-ordination is more likely to be long lasting; in the formal model, this corresponds to the probability that a new game starts, q, is small).

An alternative view of co-ordination in wage setting among individual unions is that one union acts as a wage leader vis-à-vis the rest of the labour market (Soskice and Iversen, 1998). If one union is wage leader, and all other unions follow mechanically, the situation is essentially as if wage setting were completely centralised. However, this view begs the question of why other unions follow the line initiated by the leader. If the leader is not certain that the other unions will follow the leader, this will clearly affect the wage setting of the leader. The leader may then set higher wages than it would prefer in a co-ordinated equilibrium, because of a fear that if it sets a lower wage increase, this will be exceeded by subsequent wage setters. The problems union leaders may face when they try to restrain wages is illustrated by a statement of the leader of the Norwegian unions' confederation LO (the largest union confederation, which usually acts as a wage leader in Norwegian wage

setting), that the total wage increase had been too high (Halvorsen, 1986). Another example of this dilemma is from Swedish wage setting in 1995: During the negotiation process in the engineering industry (which usually is the leading sector), the negotiators were surprised by an agreement in the forest industry giving a substantially higher increase than the mediators had planned in the engineering industry (Elvander, 1997).

Note that a wage setting sequence where one union acts as a wage leader is not incompatible with the analysis in the present paper, as long as the concern for whether subsequent wage setters set higher wages is a restriction on the wage setting of the leader. In other words, within the framework of the present paper, co-ordinated wage restraint with one union being the leader is sustainable as long as all the other unions do not gain from deviating from the line of the leader. On this explanation, wage restraint by one union being the leader might be facilitated under an accommodating central bank, as the costs of a deviation, inducing a breakdown of the wage restraint, would be more severe.

Soskice and Iversen (1998) use Germany as their leading example that a strict central bank may induce co-ordinated wage restraint. In contrast, I would argue that because Bundesbank has disciplined wage setters, their incentive to further co-ordinate wage setting has been weakened. To what extent wage setting in Germany has been co-ordinated (relative to other European countries) is not obvious (see indices in section 4 below). But relatively speaking wage setting in Germany has not been restrained: over the period 1981 to 1998, unit labour costs in German manufacturing increased by 31 percent relative to other countries (OECD Economic Outlook June 1999, Annex Table 44).

The result that there are circumstances under which co-ordination in the wage setting is feasible with an accommodating central bank but not with a strict central bank, may seem surprising and unrealistic. However, it is important to keep in mind that I compare monetary regimes with a common monetary target, and under precommitment. In contrast, in Holden

(1991a), I show that under an exchange rate target, co-ordination of wage setting may be more difficult to achieve if the exchange rate target is not credible.

Proposition 2 is based on the presumption that union behaviour can be described by a trigger strategy equilibrium. However, trigger strategy equilibria have been criticised because they are not "renegotiation proof", in the sense that if a deviation were to occur, the unions would nevertheless have an incentive to co-operate in the following period. If unions were to anticipate that they would co-operate even after a deviation, a deviation would involve no costs, and in this case the co-operation would not be sustainable in the first place (Farrell and Maskin, 1989). This argument may seem compelling in an analysis of perfectly rational players. However, renegotiation proofness is probably not an appropriate requirement in models of union behaviour. It would be very difficult for the leadership of a union to suggest wage moderation if another union had defected the previous year. Arguments like "Last year was a mistake, but they promise that this year…." will probably have trouble convincing the rank and file. Thus, a deviator cannot be certain that a deviation will be "forgotten". I find it more realistic to assume that whether or not it is possible to resume an agreement after a breakdown is determined by other aspects, rather than being inferred directly from assumptions concerning union behaviour. The best would be to have an explicit model of these other aspects, but in the absence of this, I let this be determined by an exogenous random variable.

The analysis can also be criticised from the opposite angle, that they assume too much rationality on behalf of the unions. It is true that in the real world, unions that compete for members, or union leaders that are pushed by a militant membership, may have limited scope for wage moderation. Yet it would be both unrealistic and in contrast to the standard approach in economics to assume from the outset that agents like unions neglect the future

consequences of their behaviour. How much weight unions give to the future consequences is, however, an empirical matter; in my model this would be captured by the discount factor δ.

4 Theory and data

The main empirical prediction of this paper is that wage setting is less likely to be co-ordinated in countries with a strict monetary policy. Now both co-ordination in wage setting and the strictness of monetary policy are in practice rather complex concepts, that are difficult to measure empirically. A host of different empirical measures exists. Regarding wage setting, various scholars have focussed on corporatism, centralisation or co-ordination (see discussion of empirical measures in OECD, 1997). Centralisation may also to some extent correspond to the co-ordination of the formal model in section 3, as some unions may choose joint negotiations (centralisation), and then co-ordinate with independent unions.[7] Cukierman (1992) and Iversen (1999) discuss various measures of the strictness of monetary policy/central bank independence. A striking feature for both wage setting and monetary regime is that the ranking of countries is often rather sensitive to the operational definition that is chosen.

Due to the large problems associated with empirical measurement, a robust investigation requires an extensive study of the relationship between different specifications of both concepts. This is outside the scope of the present study. Here I shall take a less ambitious approach, and show the relationship between some of the specifications used in the literature. Figure 2 shows the position of 15 OECD countries on centralisation in wage setting and hard currency regimes, based on data from Iversen (1999). Some countries have a very

[7] Furthermore, unions' choice of degree of centralisation may also depend on the monetary regime in a related way: centralisation may involve costs in the form of reduced flexibility and independence, but unions may nevertheless prefer centralisation if the costs of uncoordinated wage setting are too large.

decentralised wage setting (observations to the left in the figure), often with small union density, and in most of these countries co-ordination of wage setting is not an issue irrespective of monetary regime. However, for the observations of countries with medium and high degree of centralisation of wage setting, there is a clear tendency that a softer currency is associated with more centralised wage setting. This is consistent with the prediction of the present paper, that wage setting is more likely to be co-ordinated in countries with an accommodating monetary policy.

Figure 3, which plots the relationship between co-ordination in wage setting in a number of OECD - countries, 1990 (from OECD, 1997, table 3.3) and the index of central bank independence given by Cukierman and Lippi (1999a), provides a less encouraging picture. No clear relationship is identifiable, irrespective of whether one neglects the countries with completely decentralised wage setting. On the other hand, Figure 4, which combines Iversen's (1999) hard currency index with the centralisation of wage setting index of Golden, Lange and Wallerstein (1998), indicates a clear relationship: wage setting is more centralised in countries with weaker currencies (neglecting US, Canada and UK where wage setting is so decentralised that co-ordination is clearly not feasible). Figure 5, where Golden, Lange and Wallerstein's centralisation index is combined with Cukierman and Lippi's (1998) central bank independence index provides the same picture: centralised wage setting is combined with low central bank independence.

Overall, most of these indexes appear to be consistent with the theoretical prediction of the present paper. Note however, that even if we were to find a strong relationship between co-ordination in wage setting and accommodating monetary policy, the direction of causality would be an open issue. Clearly, the problems associated with the combination of unionised, uncoordinated wage setting and an accommodating monetary regime may lead to a change in the monetary regime, to a stricter regime, rather than to co-ordination in wage setting.

Furthermore, there are also other concerns of importance. Iversen (1999) argue that the two superior combinations are (i) centralisation of wage setting combined with an accommodating monetary regime, and (ii) intermediate centralisation combined with a non-accommodating regime.[8] However, the distributional consequences are different; some agents prefer one alternative, while others prefer the other. Under changing external circumstances, and a struggle about which combination to choose, inferior alternatives may also prevail, at least temporarily.

5 Concluding remarks

In this paper I have argued that the monetary regime affects whether co-ordinated wage restraint is feasible. Because of the existence of negative external effects in wage setting, unions have an incentive to agree on wage moderation. But usually there is some scope for individual unions to deviate from the co-operative solution, obtaining a short run gain by higher real wages. Co-ordination is only sustainable if the long-run costs associated with a likely breakdown of co-ordination outweigh the short run gains from a deviation. This depends on unions' discount factor (co-ordination is more likely if unions are patient), but it also depends on the monetary regime. A strict monetary regime disciplines wage setters by increasing the wage elasticity of employment, thus dampening the negative consequences of uncoordinated wage setting. The gains from co-ordination are greater if the central bank is accommodating, as in this case uncoordinated wage setting by unions has more detrimental effects. This implies that unions' incentives to co-ordinate their wage setting are greater if the central bank is accommodating. Thus, in this case co-ordination in wage setting may be

[8] The problem with the combination centralisation of wage setting and non-accommodating monetary policy is, according to Iversen (1999), that centralisation of wage setting has an inflationary tendency that is problematic under a non-accommodating monetary regime (as also suggested by Holden, 1991, 1998, and Calmfors, 1993).

sustainable even if unions are not patient enough to ensure co-ordination with a stricter central bank.

The analysis also sheds light on the consequences of participation in a monetary union. Uncoordinated wage setting is more costly in a country within a monetary union than in a country with country-specific inflation target. This is because in a country with a country specific inflation target, higher wages will be met with a rise in the interest rate; thus, the central bank will to some extent discipline wage setters even if they do not co-ordinate their wage setting. In contrast, in a monetary union, increased wages in a member country has little impact on the overall price level in the union, and will therefore have only negligible effect on the interest rate set by the common central bank, irrespective of the preferences of the central bank. Thus, monetary policy will not discipline the wage setters in a country participating in a monetary union. For a given degree of co-ordination of wage setting, the consequence is that the equilibrium rate of unemployment would be higher for a country within a monetary union than for a country with a country-specific inflation target (this is the argument of Soskice and Iversen, 1998, and Cukierman and Lippi, 1999b). [9]

However, the present paper shows that precisely because the costs associated with uncoordinated wage setting are larger within a monetary union, the incentives for unions to co-operate are greater. For some values of union time preferences (patience), the gains from co-ordination would be sufficient to make co-ordination sustainable within a monetary union, while they would not be sufficient outside a monetary union. In this case participation in a monetary union will involve a lower equilibrium unemployment. On the other hand, if the co-ordination in wage setting is not affected, equilibrium unemployment will be higher within the monetary union. Numerical simulations suggest that the potential gain from co-ordination

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[9] Clearly, participation in a monetary union also involves other aspects, not studied in this paper, that may affect the equilibrium rate of unemployment (Calmfors, 1998).

in wage setting is much greater than the direct effect of the monetary regime on the equilibrium rate of unemployment for a given degree of co-ordination in wage setting.

Empirical investigation of the theoretical prediction is made difficult by the fact that there is no consensus on the proper measures of co-ordination/centralisation of wage setting, nor of central bank strictness. Nevertheless, the predicted negative relationship between centralisation of wage setting and central bank strictness is apparent from several combinations of empirical indices used in the literature. While there also exists specifications of co-ordination/centralisation of wage setting and of monetary regime where there is no relationship, the broad view appears to be consistent with the prediction of the present paper, that wage setting is less likely to be co-ordinated in countries with a strict monetary policy.

Appendix: Derivation of the elasticity of labour demand λ

Total employment in firms covered by union j is

(A1) $$l_j = \frac{\bar{g} + \alpha(m-p) - \eta(p_j - p)}{\gamma}$$

The elasticity of labour demand is

(A2) $$\frac{dl_j}{dw_j} = \lambda = -\frac{\alpha}{\gamma}\frac{d(m-p)}{dp}\frac{dp}{dw}\frac{dw}{dw_j} + \frac{\eta}{\gamma}\frac{d(p_j-p)}{d(w_j-w)}\frac{d(w_j-w)}{dw_j}$$

From (5), $d(m-p)/dp = -(1-\rho)$, furthermore, $dp/dp_j = dw/dw_j = \sigma$. Total differentiation of (1), (2) and (6), and rearranging, gives us

(A3) $$\frac{dp}{dw} = \frac{\gamma}{\gamma + (1-\gamma)\alpha(1-\rho)} \qquad \text{and} \qquad \frac{d(p_j-p)}{d(w_j-w)} = \frac{\gamma}{\gamma + (1-\gamma)\eta}$$

Substituting these results into (A2) yields (12) in the main text.

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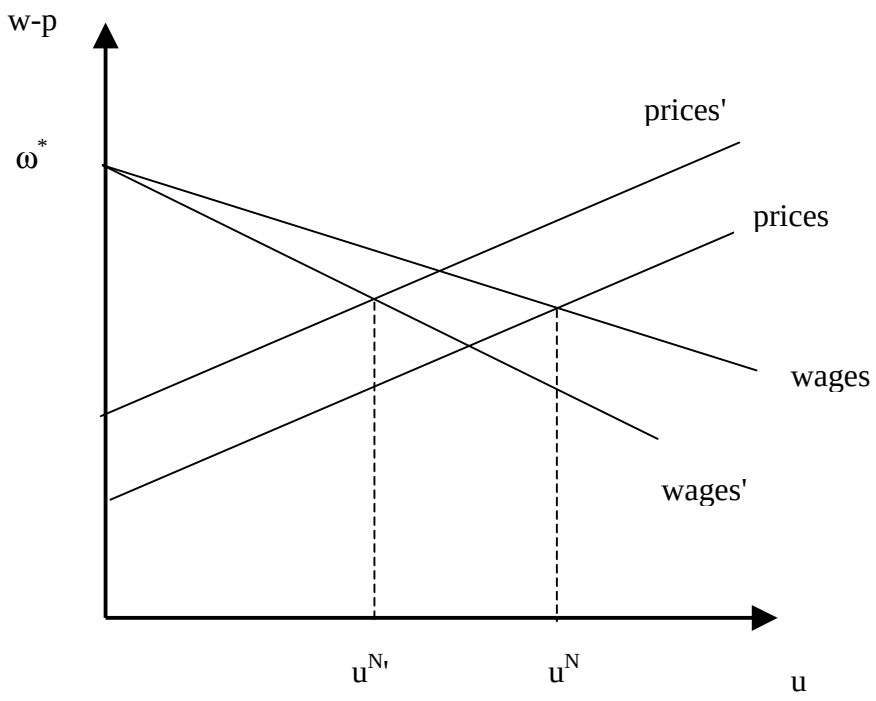

Figure 1: A stricter monetary regime increases the wage elasticity of employment, shifting the wage curve down and the price curve up, and decreasing the equilibrium level of unemployment.

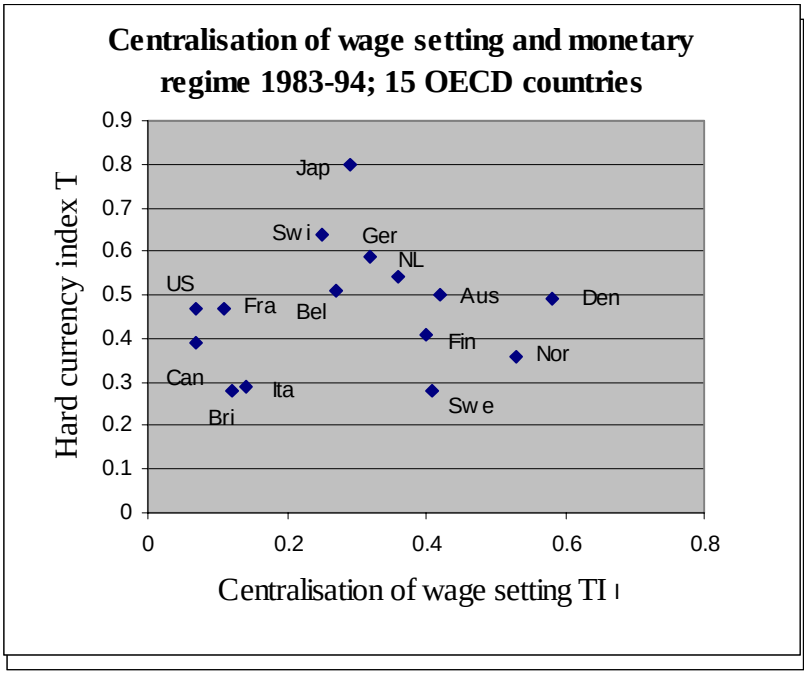

Figure 2: Sources: Iversen (1999), tables 1.2 and 1.3. Aus is Austria, NL the Netherlands, and NZ is New Zealand.

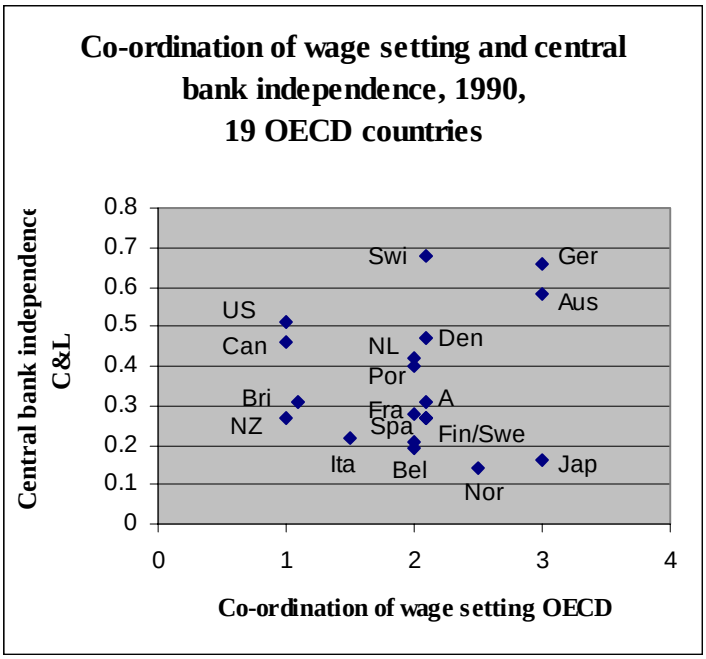

Figure 3: Sources: CBI, Cukierman and Lippi (1999a), table 1; co-ordination in wage setting 1990, OECD (1997) table 3.3. A is Australia. Finland and Sweden are at the same data point.

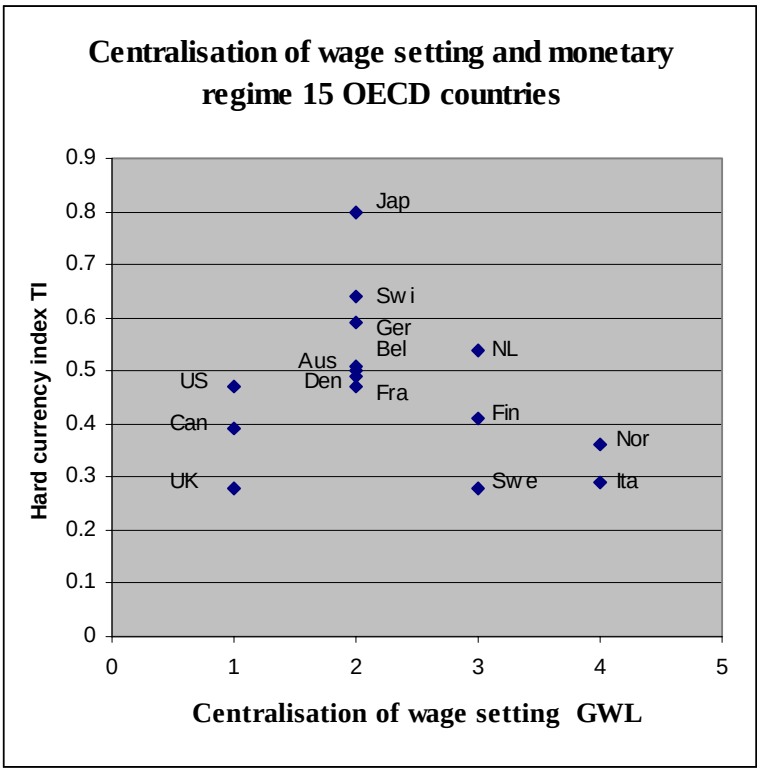

Figure 4: Sources: Wage setting, Golden-Wallerstein-Lange Labor & Political Data. Hard currency index, Iversen (1999), tables 1.3.

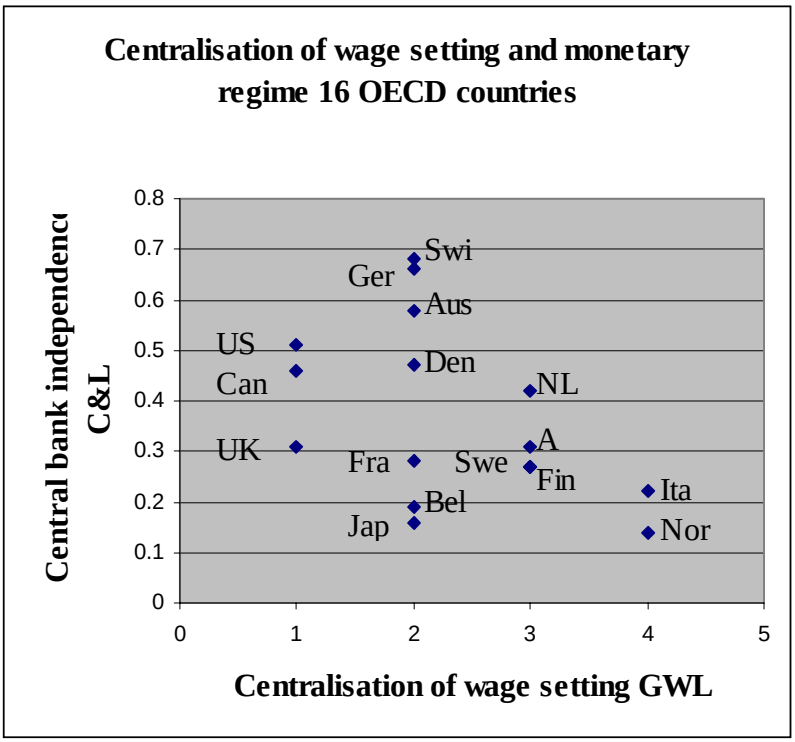

Figure 5: Sources: Wage setting, Golden-Wallerstein-Lange Labor & Political Data. CBI, Cukierman and Lippi (1999a), table 1. Finland and Sweden are at the same data point.

KEYWORDS:

Wage setting
Co-ordination
Equilibrium unemployment
Monetary regime
Monetary union