Monetary Institutions, Monopolistic Competition, Unionized Labor Markets and Economic Performance

Fabrizio Coricelli, Alex Cukierman and Alberto Dalmazzo*

January 29, 2004
Extended version

Abstract

Recent literature on the strategic interaction between unionized labor markets and monetary policymaking institutions contains two opposing views about the real effects of central bank conservativeness (CBC). This paper develops a unified framework designed to evaluate the relative merit of those two views. The model features both supply and demand channels of transmission of monetary policy to the economy. Some main conclusions are: 1. The extent of real and nominal wage stickiness depends on CBC. 2. The sign of the effect of CBC on economic performance depends on the relative inflation-unemployment aversion of unions. 3. For plausible values of this relative aversion, macroeconomic performance is better under a conservative central bank. 4. A sufficiently conservative central bank responds to wage increases by contracting the money supply, which is consistent with the pre EMU behavior of the Bundesbank. 5. CBC exerts a stronger moderating impact on unemployment and wages the higher the degree of local monopoly power on product markets.

*Fabrizio Coricelli; University of Siena and CEPR, Alex Cukierman; Tel - Aviv University, Center for Economic Research, Tilburg University and CEPR, Alberto Dalmazzo; University of Siena. We benefitted from discussions with Steinar Holden, Francesco Lippi, Asbjorn Rodseth and David Soskice and from the reactions of seminar participants at the University of Oslo, Tilburg University, Tel -Aviv University, IGIER-Milan, WBZ-Berlin, the LSE-Siena workshop and the workshop on wage bargaining within EMU at the Austrian National Bank. E-mails: Coricelli: <coricelli@unisi.it>, Cukierman: <alexcuk@post.tau.ac.il>, Dalmazzo: <dalmazzo@unisi.it>.

Keywords: Central Bank Conservativeness, Real Effects of Monetary Policy, Wage Bargaining, Monopolistic Competition. *JEL Classification*: E58, E24, E31.

1 Introduction

Does the structure of monetary institutions matter for real economic activity? Conventional wisdom maintains that, in the absence of shocks monetary institutions affect inflation but not the real economy. Recent literature challenges the conventional wisdom by showing that, when the labor market is dominated by a small or moderate number of unions, the nature of monetary policymaking institutions affects real variables.[1] A central issue addressed by this burgeonning literature is whether a more conservative central bank encourages or discourages economic activity by deterring or by encouraging unions' real wage demands.

The recent literature contains two diametrically opposed views on this issue. One, based on the presumption that unions are averse to inflation, concludes that by alleviating the inflationary fears of unions more conservative central banks induce higher real wage demands and higher levels of unemployment. In the extreme case of a monopoly union this view implies that, (abstracting from stabilization policy) a populist or ultra liberal central bank (CB) that cares only about unemployment is best for a society that dislikes both inflation and unemploment; see Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999, 2002), Lawler (2000) and Lippi (2002). The other view is that less accommodating central banks moderate unions' wage demands more by raising the fear of unemployment among their members. This view implies that both inflation and unemployment are lower under less accomodative central banks; see Bratsiotis and Martins (1999) and Soskice and Iversen (1998, 2000).

To date, evaluation of the relative merits of each of those views has not been possible because the models supporting each approach differ in structure and do not nest both mechanisms. Thus, Bratsiotis and Martin (1999) and Soskice and Iversen (2000) abstract from unions' inflation aversion and postulate that monetary policy affects the economy **only** through aggregate demand. On the other hand, while recognizing the inflation aversion of unions, the papers

[1] A non exaustive list includes Skott (1997), Jensen (1997), Gruner and Hefeker (1999), Cukierman and Lippi (1999, 2001), Guzzo and Velasco (1999), Bratsiotis and Martins (1999), Soskice and Iversen (2000), Lawler (2000), Holden (2003a, 2003b) and Vartiainen (2002). A broad survey of the issues appears in Calmfors (2001).

by Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999) and Lawler (2000) postulate that monetary policy affects the economy **only** via aggregate supply, by changing the real content of contractually fixed nominal wages.[2]

This paper proposes a framework that nests the mechanisms leading to these different points of view within a **unified** framework making it possible to identify the conditions under which either one dominates. In particular, the paper features a transmission process of monetary policy that operates via **both** aggregate supply and aggregate demand channels. The former is the traditional supply side channel in which, due to predetermined nominal wage contracts, expansionary monetary policy reduces real wages and stimulates employment by creating inflation. The other is an aggregate demand channel that operates by stimulating the demand for goods and therefore the derived demand for labor. An important advantage of this integrated formulation is that it makes it possible to identify the economic effects of the threefold interaction between CB conservativeness, centralization of wage-bargaining and product market imperfections. In particular, the impact of central bank's conservativeness on macroeconomic performance depends on the degree of imperfection in both labor and goods markets.

Additional features of this framework follow. First, prices and nominal wages are set, respectively, by monopolistically competitive firms and by labor unions with market power. Prices are fully flexible and nominal wages are contractually fixed.[3] As in New Keynesian models of the type surveyed in Clarida, Galì and Gertler (1999) a monetary expansion affects economic activity by stimulating aggregate demand. But, since prices are completely flexible, this transmission mechanism relies on wage stickiness rather than on price stickiness.[4] Second, the choice variable of the central bank (CB) is the money supply and those of labor unions are

[2] Another, secondary, difference is that Bratsiotis and Martins and Soskice and Iversen take the degree of accommodation as the primitive while the other papers take the level of (Rogoff (1985) type) CB conservativeness as the primitive. Here the degree of accommodation is determined as an endogenous function of CB conservativeness.

[3] As in Blanchard and Kiyotaki (1987) each individual firm has some market power in the goods' market but no market power in the labor market. But labor supply and consumer demand for the differentiated products of firms are taken as primitives rather than derived from a Dixit-Stiglitz (1977) utility.

[4] Although our framework does not feature Calvo type price rigidities, prices are not adjusted proportionally to changes in the money supply due to the existence of contractually fixed nominal wages. Casual observation, as well as more systematic work, like that of Stigler and Kindhal (1970), supports the view that this is a realistic formulation.

their respective nominal wages.[5]

As a byproduct the paper provides an integrated framework for much of the recent literature on the various channels through which monetary policy and institutions interact with imperfectly competitive labor and product markets. It shares with some of this literature the feature that the relative bargaining power of unions and of firms depends on the nature of monetary institutions. A novel feature of our framework is that it clarifies how this relative bargaining power varies with the level of CB conservativeness when monetary policy affects the economy via both demand and supply channels.[6] In particular, the paper uncovers the different channels through which the relative inflation-unemployment aversions of unions and of the CB affect real and nominal wages.

An illustrative flash forward into the basic intuition underlying some of those effects follows. When an individual union raises the nominal wage of its members, it triggers an increase in the relative prices of the goods of the firms that use its labor. This action has two consequences. First, the derived demand for labor of the affected firms goes down, increasing unemployment among union's members. Second, inflation rises. The CB dislikes both higher unemployment and higher inflation. But it cannot fully offset both effects since it possesses only one instrument. Depending on its preferences, the CB decides whether to use monetary policy to counteract the impact of the wage increase on inflation, or on unemployment. If the CB is highly averse to inflation and the union relatively averse to unemployment, the union will be deterred from asking high wages since it anticipates that the policy reaction of the CB will raise unemployment by a lot. In this case, the more conservative the CB, the lower the bargaining power of unions. But if the union is relatively more averse to inflation the deterrent effect will be small since the union anticipates that the policy response of the, relatively conservative CB, will not raise inflation by much. In this case, the more conservative the CB, the **higher** the bargaining power of unions. Hence, a relatively **liberal** CB that inflates a lot in response

[5] Cubitt (1992) was one of the first to formulate a model of strategic monetary policy in which the CB affects the price level through its choice of money supply and a (single) union chooses the nominal wage.

[6] A related novelty in comparison to the frameworks in Bratsiotis and Martin (1999) and in Soskice and Iversen (1998, 2000) is that it relates the, endogenous in our framework, reaction function of the CB to the Bank's effective conservativeness or independence while those papers take the reaction function as a primitive. This makes it possible to relate the theoretical predictions of the paper to existing empirical evidence on the relation between the degree of accomodation and CB independence. Details appear in subsection 2.2.

to unemployment moderates the bargaining power of unions as in the 'populist CB' literature reviewed above.

In view of this literature a significant result of the paper is that, when there is more than one union and unions care sufficiently more about unemployment among their members than about inflation, an **ultra conservative** CB that is concerned only about price stability reduces both inflation and unemployment to their minimal possible levels. This supports the view that the result on the social desirability of an ultra liberal or populist CB (Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999), as corrected by Lippi (2002), and Lawler (2000)) is a rather extreme special case.[7]

Besides making it possible to integrate and evaluate the relative merits of different existing approaches to the strategic interaction between unions and the CB the paper sheds new light on the strategic interaction between the Bundesbank, when it conducted monetary policy, and labor unions in Germany. Our analysis implies that a sufficiently conservative central bank finds it optimal to respond to a wage increase by **reducing** the money supply, and thus aggregate demand. Provided that wage bargaining is sufficiently centralized and unions sufficiently sensitive to unemployment, this discourages excessive wage demands, leading to lower unemployment and inflation. As far as we know, this is the first time that this channel is modeled explicitly in a general equilibrium framework. Both casual and econometric evidence suggest that it has been operating in Germany where the Bundesbank often tightened monetary policy in response to "excessive" wage settlements.[8] An important corollary is that the degrees of both nominal and real wage rigidity depend on the level of central bank conservativeness.[9] This is an instance of the Lucas critique.

[7] However, *if* workers are inflation-averse, the result that an ultra liberal CB is socially optimal still holds in the case of a **single monopoly** union. Such a possibility is excluded by assumption in Bratsiotis and Martins (1999) and Soskice and Iversen (1998, 2000) since their frameworks abstract from the possibility of inflation aversion on the part of unions. See also footnote 33. A broader discussion of this issue appears in section 2 of Calmfors (2001).

[8] Studies on industrial relations in Germany report that when it considered wage settlements to be excessively inflationary the Bundesbank often threatened to tighten monetary policy, thereby raising unions' fears from unemployment; see Berghan and Detlev (1987), Hall (1994), Streek (1994), and Hall and Franzese Jr. (1998). In addition estimates of the Bundesbank reaction to domestic wage inflation during the seventies and the eighties reveal that the Bundesbank has reduced the rate of high power money growth in response to increases in wage inflation: see Cukierman, Rodriguez and Webb (1998), Table 4.2, p. 93.

[9] Gali, Gertler and Lopez-Salido (2001) argue that labor market frictions may help account for the observed inertia in inflation and real marginal costs in Europe.

The paper is organized as follows. The model and the characterization of equilibrium are presented in section 2. The effects of central bank conservativeness, centralization of wage bargaining and the degree of product differentiation on inflation and unemployment are discussed in section 3. Section 4 presents new results concerning the socially optimal level of CB conservativeness. This is followed by concluding remarks that include a comparison to recent literature on unionized labor markets and monetary policy. Proofs are in the Appendix.

2 The model

The economy is composed of a continuum of monopolistically competitive firms and of n, equally sized, labor unions that organize the entire labor force. The firms are evenly distributed over the unit interval and their mass is one. Thus, each union covers the labor force of a fraction $1/n$ of the firms. A quantity L_0 of workers, equal across firms, is attached to each firm but works only if the union in charge signs a labor contract with the firm. For convenience, and without loss of generality, the firms are indexed so that all firms whose labor force is represented by union i are located in the contiguous subinterval $(\frac{i}{n}, \frac{i+1}{n})$ of the unit interval, where $i = 0, 1..., n-1$. Each firm owns a production technology that exhibits decreasing returns to scale to labor input, and is given by

$$Y_{ij} = L_{ij}^{\alpha}, \quad \alpha < 1 \tag{1}$$

where Y_{ij} and L_{ij} are output supply and labor input of firm j. The index i means that the labor force of the firm belongs to union i. Each firm faces a demand for its output given by

$$Y_{ij}^{d} = \left(\frac{P_{ij}}{P}\right)^{-\eta} \frac{M}{P}, \quad \eta > 1 \tag{2}$$

where P_{ij} and P are respectively the price of the individual firm and the general price level, M is the aggregate nominal money supply, and η is the (absolute value of the) elasticity of demand facing the individual firm with respect to its relative price. Equation (2) states that the demand facing the individual firm is increasing in real money balances and decreasing in the relative

price of its product.[10] The general price level is defined as the integral, over the unit interval, of the (logaritms of) the prices of individual firms. It is convenient, for reasons that will become clearer later, to write it as

$$p = \frac{1}{n}\sum_{i=0}^{n-1}\left(\frac{\int_{\frac{i}{n}}^{\frac{i+1}{n}} p_{ij}\ dj}{\int_{\frac{i}{n}}^{\frac{i+1}{n}} dj}\right) = \sum_{i=0}^{n-1}\int_{\frac{i}{n}}^{\frac{i+1}{n}} p_{ij}\ dj\ = \int_0^1 p_{ij}\ dj. \tag{3}$$

where p_{ij} is the logarithm of P_{ij} and p is the logarithm of P. It suffices to note at this stage that this way of expressing the general price level facilitates the identification of the firms that are affected by an increase in the nominal wage rate set by union i.

Monetary institutions are represented by a CB that dislikes both inflation and unemployment. The CB loss function is given by

$$\Gamma = u^2 + I\pi^2 \tag{4}$$

where u and $\pi \equiv p - p_{-1}$ are respectively the aggregate rate of unemployment and of price inflation. As in Rogoff (1985), the parameter I denotes the degree of CB conservativeness to which we shall occasionally refer as central bank independence (CBI).[11] It measures the relative importance that the CB assigns to the objective of low inflation versus low unemployment. The policy instrument of the CB is the nominal money supply, M.

Each union likes a higher real wage, dislikes unemployment among its members, and

[10] The demand function in equation (2) can be derived from a more basic formulation in which each individual chooses consumption so as to maximize his utility subject to his wealth constraint. Details appear in chapter 8 of Blanchard and Fischer (1989). More broadly, as well as more realistically, the effect of real money balances on demand can be thought of as reflecting a whole variety of demand induced effects of real balances on demand. Those include the well known Keynes-Tobin effect of monetary expansion on demand via a lower interest rate, the Bernanke-Gertler credit channel as well as the narrow, Pigou-Patinkin, real balance effect. When real balances go up they generally stimulate demand through all those channels. We will therefore sometimes refer to the total impact of real balances on demand as a "generalized" real balance effect. A detailed discussion of these various channels appears in chapter 25 of Mishkin (2001). An overview appears in figure 1 of that chapter. A specification in which the CB affects real balances through the choice of interest rate appears in Coricelli, Cukierman and Dalmazzo (2001).

[11] The rationale for this terminology is discussed in footnotes 8 and 12 of Cukierman and Lippi (1999). The specification of the CB loss function abstracts from the incentive of the CB to expand output in order to overcome the welfare inefficiency caused by monopolistic competition stressed by Woodford (1999). This modeling strategy is adopted in order to highlight the incentive of the CB to expand employment above the level implied by unions' wage policy. We believe this is a more realistic description of what variables central banks actually look at, at least for Europe.

possibly (but not necessarily) dislikes inflation. The individual union's loss function is given, as in Cukierman and Lippi (1999), by

$$\Omega_i = -2w_{ri} + Au_i^2 + B\pi^2 \tag{5}$$

where w_{ri} is the (logarithm) of the real wage of union's i members, u_i is the rate of unemployment among them, A is a positive parameter that measures the relative importance attributed to employment versus the real wage by the union's leadership, and B is a non negative parameter that characterizes the union's degree of inflation aversion. The first two arguments reflect the union's sectoral interest and are standard in the theory of trade unions' behavior.[12] The third reflects the union's aversion to inflation and appears rather often in the recent literature on the strategic interaction between unions and the CB.[13] Although the union cares about the real wage, it directly sets only the nominal wage.

To bring out the strategic interaction between unions and the monetary authority, as well as the effects of their behavior on the pricing strategies of firms, we postulate that monetary policy actions are more flexible than the decisions about the nominal wage made by the unions. To focus on the consequences of nominal wage stickiness we assume that product prices are flexible, in the sense that firms can immediately and costlessly adjust their prices to observed changes in monetary policy.[14] These assumptions lead to the following, three-stage, sequence of events

In the first stage, each union chooses its nominal wage so as to minimize its loss function (5). In doing that, each union takes the **nominal wages** of other unions as given and anticipates

[12] See Oswald (1982) for example. The existence of a tradeoff between real wage and employment considerations in the union's objectives is consistent with political economy considerations of the type emphasized by Saint-Paul (2000) for example . In particular, since the majority of union members is employed the real wage-employment combination desired by the union management typically involves a positive levels of unemployment.

[13] Inflation averse unions have appeared *inter alia* in Cubitt (1992), Gylfason and Lindbeck (1994), Jensen (1997), Skott (1997), Cukierman and Lippi (1999, 2001), Guzzo and Velasco (1999) and Lawler (2000).

[14] Wage stickiness is less controversial and undoubtedly better documented than price stickiness. Stigler and Kindhal (1970) present evidence suggesting that, due to discounts, extras and product repackaging, the behaviour of industrial prices is substantially more flexible than what might appear to be the case from just looking at list prices. The belief that much of observed price sluggishness is due to contractually fixed wages also leads us to locate price decisions by firms in the last stage of the game. This is a relevant difference from models like Bratsiotis and Martins (1999) and Soskice and Iversen (2000), which assume that pricing decisions are taken before money supply is set.

the reactions of the monetary authority and of firms to its wage choice. The resulting nominal wages remain contractually fixed for the duration of the game. In the second stage the monetary authority chooses the nominal stock of money so as to minimize its loss function (4). In doing that, the CB takes the preset nominal wages as given and anticipates the reaction of firms both to wages and to its choice of money supply.[15] In the third stage each firm takes the general price level as given and sets its own price so as to maximize its real profit. [16]The resulting string of first order conditions, together with equation (3), simultaneously determine individual prices as well as the general price level.

General equilibrium is characterized by backward induction: we start by solving the firms' pricing problem, then the CB problem, and finally we solve for the unions' wage decisions.

2.1 Price setting by monopolistically competitive firms

Real profits of an individual firm are given by

$$\Pi_{ij} = \frac{P_{ij}}{P} Y_{ij}^d - \frac{W_i}{P} L_{ij} = \left(\frac{P_{ij}}{P}\right)^{1-\eta} \frac{M}{P} - \frac{W_i}{P} \left[\left(\frac{P_{ij}}{P}\right)^{-\eta} \frac{M}{P}\right]^{\frac{1}{\alpha}} \tag{6}$$

where the second equality is obtained by using (2), the demand facing the individual firm, and (1), the production function. In the third stage of the game, the firm takes P, M and the nominal wage, W_i, as given and chooses its own price, P_{ij}, so as to maximize real profits. Maximizing with respect to P_{ij}, taking logarithms and rearranging yields:

$$p_{ij} - p = \theta + \frac{1}{\alpha + \eta(1-\alpha)} \left[\alpha(w_i - p) + (1-\alpha)(m-p)\right] \tag{7}$$

where $\theta \equiv \left[\frac{\alpha}{\alpha+\eta(1-\alpha)}\right] \log \left[\frac{\eta}{\alpha(\eta-1)}\right]$ and lower case letters stand for the logarithms of the corresponding upper case letters. Equation (7) states that the optimal relative price of a typical monopolistically competitive firm is higher the higher the real wage it pays and the higher real

[15]Jerger (2002) considers, inter alias, the case in which the CB and unions move simultaneously rather than sequentially. Again, since monetary policy is adjusted more frequently than nominal contracts, our assumption that unions move first appears to be more in line with reality.

[16]By contrast, Bratsiotis and Martin (1999) assume that firms act as Stackelberg leaders with respect to the central bank. Since the number of firms in most economies is generally large, our assumption that, in setting its price, each firm takes the behavior of the CB as given appears as more realistic.

money balances. The first element reflects the firm's reaction to labor costs and the second its reaction to the demand for its product. The firm's derived demand for labor can be obtained by equating the product demand (equation (2)) with the firm's supply (equation (1)). Taking logarithms and rearranging gives:

$$l_{ij}^d = \frac{1}{\alpha}\left[-\eta(p_{ij} - p) + (m - p)\right]. \tag{8}$$

Equation (8) states that the individual firm's derived demand for labor is an increasing function of real money balances and a decreasing function of its relative price. Using equation (7) in equation (8), we obtain an alternative form of the firm's demand for labor

$$l_{ij}^d = \kappa + \frac{1}{\alpha + \eta(1-\alpha)}\left[-\eta(w_i - p) + (m - p)\right] \tag{9}$$

where $\kappa \equiv -\frac{\eta\theta}{\alpha}$. This form implies that when the union manages to raise the real wage, the firm's demand for labor goes down unless real money balances increase. This feature of the labor demand plays a crucial role in what follows.

2.2 Choice of money supply by the CB

The CB picks the money supply in the second stage so as to minimize its loss function (4), after observing nominal wages and anticipating the pricing and employment reaction of the firms to its own choice (as given by equations (7) through (9)). Averaging equation (7) over firms and rearranging, we obtain

$$(m - p) = \rho - \frac{\alpha}{(1-\alpha)}(w - p) \tag{10}$$

where $\rho \equiv \frac{-\alpha}{(1-\alpha)} \log\left[\frac{\eta}{\alpha(\eta-1)}\right]$ and p and w are respectively the logarithms of the average price and the average nominal wage. Equation (10) states that, in the aggregate, there is an inverse **equilibrium** relation between the average real wage and real money balances. The equilibrium general price level can now be obtained by rearranging equation (10)

$$p = -(1-\alpha)\rho + \alpha w + (1-\alpha)m. \tag{11}$$

Thus, except for a constant that depends on the basic parameters of the economy, the equilibrium price level is a weighted average of nominal wages and of the nominal money supply. Correspondingly, the rate of inflation is given by

$$\pi = p - p_{-1} = -(1-\alpha)\rho + \alpha w + (1-\alpha)m - p_{-1}. \tag{12}$$

We now turn to a characterization of unemployment. By averaging equation (8) over firms and exploiting (3), one obtains the average employment per firm:

$$l^d = \frac{1}{\alpha}(m-p). \tag{13}$$

Since the total mass of firms is one, l^d also coincides with aggregate demand for labor. In contrast with "supply-side" models where the CB picks inflation directly, equation (13) reflects the "flex-price-sticky-wage" New Keynesian feature of our model, where monetary policy affects employment not only via supply but also through aggregate demand.

Let $l_0 \equiv \log[L_0]$ be the logarithm of labor supply per firm. The average rate of unemployment per firm, as well as the average economy-wide rate of unemployment, are given by

$$u = l_0 - \frac{1}{\alpha}(m-p). \tag{14}$$

Taking the average nominal wage w as given, the CB chooses the nominal stock of money m so as to minimize its loss function. Substituting the expressions for inflation and unemployment (equations (12) and (14)) into equation (4) and rearranging, the CB problem becomes

$$\min_{\{m\}} \left\{ \begin{array}{c} \left[l_0 - m + \frac{1}{\alpha}\left(-\rho(1-\alpha) + \alpha w\right)\right]^2 + \\ +I\ \left[(-\rho(1-\alpha) + \alpha w + (1-\alpha)m) - p_{-1}\right]^2 \end{array} \right\}. \tag{15}$$

This yields a reaction function for the CB in which the money supply is a linear function of the average nominal wage:

$$m = \mu + \frac{1-\alpha(1-\alpha)I}{1+(1-\alpha)^2 I}\ w. \tag{16}$$

where $\mu \equiv \frac{l_0 - \frac{\rho(1-\alpha)}{\alpha} + [\rho(1-\alpha)+p_{-1}](1-\alpha)I}{1+(1-\alpha)^2 I}$. Depending on the degree of CB conservativeness (or

independence) I, the CB either counteracts or accommodates an increase in nominal wages. If the CB is sufficiently conservative, in the sense that $1-\alpha(1-\alpha)\ I<0$, a nominal wage increase will trigger a tightening of the money supply. This is a central implication of our paper that is consistent with the behavior of the Bundesbank in the pre EMU period. Conversely, if the CB is relatively liberal, in the sense that $1-\alpha(1-\alpha)\ I>0$, it will partially accommodate wage increases.

The intuition underlying this result is as follows. Firms respond to an increase in nominal wages by increasing their prices. This raises the rate of inflation and, for a given nominal money supply, reduces real money balances. The second effect reduces the derived demand for labor and pushes unemployment up. The upshot is that, in the absence of any reaction by the CB, an increase in the average level of nominal wages raises both inflation and unemployment. The response of the CB is designed to optimally spread the costs of those two "bads" between the two components of its loss function. If it cares relatively more about price stability, the CB partially counteracts the effect of wage increases on inflation at the cost of even higher unemployment. If it cares relatively more about unemployment, the CB partially counteracts the adverse effect of higher wages on unemployment at the cost of even higher inflation.

Casual evidence about the industrial organization of labor negotiations in Germany as well as recent empirical evidence concerning monetary policy reaction functions supports the theoretical discussion above. Studies on industrial relations in Germany like Berghan and Detlev (1987) and Streek (1994) report that the Bundesbank often threatened to tighten monetary policy in response to excessive wage settlements. Hall (1994, p.12) and Hall and Franzese Jr. (1998) note that, due to the high level of independence of the Bundesbank, labor unions usually took this threat seriously but that, from time to time, the German CB actually tightened monetary policy in response to high wage settlements in order to maintain its credibility. This point of view is corroborated by empirical reaction functions from Cukierman, Rodriguez and Webb (1998) that provide estimates of the degree of monetary accommodation (characterized by the reaction of high powered money growth to wage inflation) in a group of developed economies between the mid-seventies and the beginning of the nineties. Cukierman *et. al.* find that in countries with low CBI the coefficient of accommodation tends to be significantly positive; in countries with intermediate levels of CBI it is insignificantly different from zero; and in high

CBI countries like Germany and Austria it is significantly negative. More generally table 4.4 in that paper shows that the degree of accomodation, as measured by the reaction of high powered money to nominal wage increases adjusted for significance, is a decreasing function of CBI. Those findings support a reaction function of the type that appears in equation (16). In countries with a highly independent CB, the monetary authority leans against inflationary wage increases by contracting money growth in response to wage inflation.

2.3 Choice of wages by the unions

In the first stage of the game each union takes nominal wages set by other unions as given and chooses its own nominal wage so as to minimize its losses, given by equation (5). In doing so, each union takes into consideration the consequences of its wage policy for the prices that will be subsequently set by firms, as well as the response of the CB in equation (16).

Let w_i and w_{-i} be respectively the nominal wage of union i and the average nominal wage of all other unions. Taking w_{-i} as given, union i sets a common wage w_i for all its members, which are all the workers attached to firms in the interval $[\frac{i}{n}, \frac{i+1}{n}]$. The relevant average rate of unemployment per firm is given by the difference between the number of workers attached to each firm and the average labor demand for a firm represented by union i:

$$u_i = l_0 - \left\{ \frac{\int_{i/n}^{(i+1)/n} l_{ij}^d \, dj}{\int_{i/n}^{(i+1)/n} dj} \right\} = l_0 - l_{ij}^d. \tag{17}$$

From equation (8), labor demand l_{ij}^d of firm j in the interval $[\frac{i}{n}, \frac{i+1}{n}]$ is a function of aggregate real money balances and of its relative price. Since all firms in the interval $[\frac{i}{n}, \frac{i+1}{n}]$ face a common nominal wage w_i, equation (7) implies that $p_{ij} = p_i$ for all $j \in [\frac{i}{n}, \frac{i+1}{n}]$. Consequently, union i anticipates that all the firms employing its members will react to a common wage level by setting the *same* relative price for their products. Thus, equation (17) can be rewritten as:

$$u_i = l_0 + \frac{1}{\alpha} \left[\eta \left(p_i - p \right) - \left(m - p \right) \right]. \tag{18}$$

Note that u_i is also equal to the unemployment *rate* among union i's members. Minimizing the loss function in equation (5) with respect to the nominal wage w_i subject to equation (12)

yields the following first order condition

$$-\left[1-\frac{dp}{dw_i}\right]+A\ u_i\ \frac{du_i}{dw_i}+B\,\pi\,\frac{dp}{dw_i}=0 \tag{19}$$

This condition holds for all unions ($i=1,..,n$). This system of n first order conditions implies that the equilibrium is *symmetric in both prices and wages*, that is, $w_i=w$ and $p_{ij}=p_i=p$ (see appendix for a proof). To emphasize the impact of monopolistic unions on equilibrium outcomes, we express the (symmetric) solution to the unions' game in terms of the wage premium ϕ, defined as the difference between the common real wage of each union, w_r, and the competitive real wage, $w_r^c=-(1-\alpha)l_0+\frac{1-\alpha}{\alpha}\rho$.[17] It is shown in the appendix that the equilibrium premium is given by

$$\phi\equiv w_r-w_r^c=\frac{(1-\alpha)^2IZ_w}{(1-\alpha)AIZ_u+B(1-Z_w)} \tag{20}$$

where

$$1-\frac{dp}{dw_i}\equiv Z_w=1-\frac{1}{n\left[1+(1-\alpha)^2I\right]}>0 \tag{21}$$

and

$$-\frac{dl_{ij}^d}{dw_i}=\frac{du_i}{dw_i}\equiv Z_u=\frac{1}{\alpha}\left[\eta\frac{d(p_i-p)}{dw_i}-\frac{d(m-p)}{dw_i}\right]=\frac{1}{n}\left[\frac{\eta(n-1)}{\alpha+\eta(1-\alpha)}+\frac{(1-\alpha)I}{1+(1-\alpha)^2I}\right]>0. \tag{22}$$

Notice that the wage premium is always non negative and that it increases with Z_w and decreases with Z_u and B. Z_w is the overall elasticity of the union's **real** wage with respect to the nominal wage. Z_u is the (absolute value of) the overall elasticity of employment (and of unemployment) among union members with respect to the union's nominal wage. The overall elasticities, Z_w and Z_u, internalize the subsequent reactions of monetary policy and of prices to union i's wage decision.

The expression for Z_u embeds (n, η, I), the central parameters of the model. Note first

[17] The competitive real wage is derived in the appendix.

that Z_u is larger the higher the centralization of wage bargaining (the lower n). Further, for any given n, the marginal impact of a nominal wage increase on the union's unemployment is composed of two effects: a *relative price* effect, and a *real balance* effect; see equation (8). The relative price effect works through goods substitution. When a union raises its nominal wage, the firms employing its labor will increase their prices relative to competitors, and will experience a reduction in product demand. Consequently, the demand for the union's labor falls. This effect is captured by the first term in brackets in each of the expressions in equation (22). Not surprisingly, the size of this effect depends on the parameter η, characterizing the degree of substitutability among consumption goods. The larger η, the larger the substitutability between products of different firms and, thus, the larger the substitutability between the labor of different unions. The real balance effect is given by the second terms in brackets in equation (22), and captures the marginal impact on the union's labor demand of a higher nominal wage through lower real money balances. The decrease in money balances due to a higher wage-level is generated both by an increase in the price-level, and by the monetary policy response which, as shown above, may be either positive or negative depending on the level of CBI. However, the combined impact of those two components on real balances is always negative. Hence, the overall effect of an increase in the nominal wage on employment via the real balance effect is always negative too. Furthermore, the size of this effect is higher the higher is CBI, as denoted by I.[18] This fact plays an important role in what follows.

The overall rate of unemployment, u, and the aggregate price level, p, can be expressed as simple functions of the wage premium. From equations (14) and (10), the equilibrium rate of unemployment is

$$u = \frac{1}{1-\alpha}\ \phi \tag{23}$$

Using the CB reaction function (equation (16)) in equation (12), and rearranging, the equilibrium rate of inflation can be expressed as

[18] Not surprisingly in the particular case $I = \frac{1}{\alpha(1-\alpha)}$, in which the CB does not react to wage changes, the real wage and the wage premium do not depend on CBI.

$$\pi = p - p_{-1} = \frac{1}{(1-\alpha)^2 I}\phi. \tag{24}$$

3 The effects of CBI, centralization of wage bargaining and the degree of product differentiation on economic performance

We now investigate how the wage premium, unemployment and inflation are affected by: *(i)* CBI, as characterized by I, *(ii)* the centralization of wage bargaining, as characterized by n, and *(iii)* the degree of product differentiation, as characterized by η.

3.1 CBI and economic performance

A quick look at equations (20) through (22) reveals that I affects the bargaining power of the union, and therefore the equilibrium wage premium. The direction of this effect depends on the aversion of the union to inflation in comparison to its aversion to unemployment among the union's members. The following proposition shows that when unions' inflation aversion, B, is small relative to its unemployment aversion, A, the wage premium, the rate of unemployment, and inflation are all lower the higher the degree of CB conservativeness (or CBI), I.

Proposition 1 *A necessary and sufficient condition for*

$$\frac{d\phi}{dI} < 0,\ \frac{du}{dI} < 0,\ \frac{d\pi}{dI} < 0$$

is

$$\frac{B}{A} < \left(\frac{B}{A}\right)_c \equiv \frac{\alpha(1-\alpha)^2(n-1)I^2}{[\alpha+\eta(1-\alpha)]\left[(n-1)+2n(1-\alpha)^2 I\right]}.$$

Proof. See Appendix. ■

In words the proposition states that the real wage premium, unemployment and inflation are all lower the more conservative the CB, if and only if, the relative aversion of the union to inflation

and to unemployment among its members is below some threshold. The intuition underlying this condition follows. An increase in the degree of CB conservativeness triggers two opposing effects on the wage premium. These effects are generated by "fear of inflation" and by "fear of unemployment" on the part of unions. On one hand, a more conservative CB reduces the unions' concerns for price-inflation, inducing more wage aggressiveness.[19] On the other hand, a more conservative CB favors wage moderation on the part of unions, since a conservative CB will provide little accomodation and may even tighten the money supply in response to wage pressure, generating higher unemployment. In effect, as a by-product of its worry for price stability, a conservative CB is expected to punish higher wages by raising unemployment. Thus, the deterrence exerted on unions through their fear of unemployment is stronger when the CB is more conservative.[20]

When the condition $\frac{B}{A} < \left(\frac{B}{A}\right)_c$ is satisfied, an increase in I raises unions' fears of unemployment by more than it alleviates their inflationary fears. This implies that a higher level of CBI is conducive to less inflation, as well as to **lower unemployment.** When $\frac{B}{A} > \left(\frac{B}{A}\right)_c$, an increase in I raises unions' unemployment fears by less than it alleviates their inflationary fears, causing an increase in the wage premium. The ratio $\frac{B}{A}$ characterizes the relative aversion of a typical union to inflation in comparison to unemployment among its members. Given $\frac{B}{A}$, and since $\left(\frac{B}{A}\right)_c$ depends on the level of CB conservativeness, I, it is instructive to reformulate the condition in proposition 1 also in terms of I. This is done in the following corollary to proposition 1.

[19] As in Cukierman and Lippi (1999) this happens for two reasons. First a stronger anti-inflationary stance on the part of the CB means that a unit increase in the nominal wage translates into a larger increase in the real wage (Z_w is higher). Second, an increase in CB conservativeness reduces the inflationary cost of a given nominal wage increase for inflation-averse unions ($B > 0$).

[20] A similar conclusion appears both in Bratsiotis and Martins (1999) and Soskice and Iversen (2000). However, these papers have the limitation of postulating the monetary policy rule, rather than deriving it endogenously from CB's preferences. In particular, Bratsiotis and Martins (1999, p.244) only consider the case where an increase in the price level will trigger a *reduction* in money supply. By contrast, Soskice and Iversen (2000) only consider the case where an increase in the price level will trigger a (less than proportional) *increase* in the money supply. To facilitate comparison with Soskice and Iversen's results, we first re-express the money-supply rule (16) in terms of prices. Combining equation (16) with the expression for the (log of the) price-level (11), the reaction function of the CB can be expressed as: $m = \theta_0 + [1 - \alpha(1-\alpha)I]p$, where θ_0 is a constant (Notice that $sgn(\frac{dm}{dp}) = sgn(\frac{dm}{dw})$). Taking anti-logs, our reaction function can be expressed, in terms of Soskice and Iversen's formulation, as $M = \Theta_0 \cdot (P)^{1-\alpha(1-\alpha)I}$, where Θ_0 is a positive constant. Since $I \in [0, \infty)$, it follows that $[1 - \alpha(1-\alpha)I] \in (-\infty, 1)$. Soskice and Iversen simply assume that the CB follows the (exogenously given) reaction function $M = P^a$, where $a \in [0, 1]$. This restriction on a **excludes** the possibility that a CB may react to price (or wage) increases by *reducing* the money supply.

Proposition 2 *: An increase in the degree of central bank conservativeness, I, induces a reduction or an increase in the wage premium, ϕ, depending on whether I is larger or smaller than a non negative critical value, I_c, whose explicit form is given by*

$$I_c \equiv \frac{n}{n-1}\frac{D}{\alpha}\frac{B}{A} + I_{na}\sqrt{D\left((1-\alpha)^2\left(\frac{n}{n-1}\right)^2 D\frac{B}{A} + \alpha\right)}\sqrt{\frac{B}{A}}$$

where

$$D \equiv \alpha + \eta(1-\alpha).$$

Proof. *See Appendix.* ■

The proposition implies that the equilibrium wage premium is an inverted-U function of the level of CB conservativeness. When the CB is more liberal than I_c the deterring effect of monetary institutions on real wage demands is dominated by unions' aversion to inflation. When the CB is more conservative than I_c the deterring effect is dominated by unions' fear of unemployment among their members. To elaborate, given the unions' aversion to inflation relative to unemployment, $\frac{B}{A}$, an increase in I in the range below I_c alleviates the inflationary fears of unions by more than it raises their fears from unemployment. Above I_c a similar increase raises unions' fear from unemployment by more than it alleviates their fear from inflation. The critical level, I_c, is positively related to the relative aversion of a typical union to inflation in comparison to unemployment as characterized by the ratio $\frac{B}{A}$. The lower the relative aversion of unions to inflation, the lower is the critical value, I_c, and the wider, therefore, the range of values of I for which an increase in CB conservativeness reduces the wage premium. In the extreme case in which unions are not averse to inflation at all ($B = 0$) the wage premium and CB conservativeness are negatively related over the entire range of I.

3.2 Centralization of wage bargaining and economic performance

The following proposition characterizes the relation between economic performance and decentralization in wage-setting.

Proposition 3 *The wage premium, the rate of unemployment and inflation are all increasing*

in the degree of decentralization of the labor market, as measured by the number of unions, n.[21]

Proof. See Appendix. ■

The unambiguous result in proposition 3 is the sum of a number of effects some of which operate in opposite directions.[22] In order to understand the various channels through which decentralization affects the wage premium, we examine the effect of n on Z_w and Z_u, defined in Section 2.3. An increase in n unambiguously raises Z_w, leading to a *higher* wage premium. When the labor market is highly decentralized (n large), the increase in the nominal wage of a typical union has a small impact on the aggregate price level p. Thus, the marginal gain to the union in terms of real wage is relatively large.[23] However, the impact of an increase in n on Z_u is ambiguous in general, as the relative price effect and the generalized real balance effect react in opposite direction to changes in n. An increase in n raises Z_u through the *relative price effect*, and tends to *reduce* the wage premium. This reflects the fact that when the fraction $1/n$ of firms affected by an adverse price change is small, competition is stronger because consumers find it easier to shift their demand towards goods produced by firms whose unions did not raise wages. The second component of Z_u captures the impact of the generalized *real balance effect* on firms' labor demand. When n is larger, each union perceives that an increase in its nominal wages will have a negligible effect on the *aggregate* wage level w, which eventually determines the magnitude of the reaction by the CB. Therefore, an increase in n tends now to *increase* the wage premium, since unions internalize the adverse effects of a nominal wage increase to a lesser extent.

Proposition 3 states that, although the competition effect of more decentralization operates in the model, it is dominated by the strategic effects. Thus, the present model does not generate the "hump-shaped" relation between unemployment and labor market centralization

[21] *In the extreme cases* $n = 1$ *and* $n \to \infty$ *the wage premium is given respectively by* $\phi(n=1) = \frac{(1-\alpha)^4 I^2}{(1-\alpha)^2 I^2 A + B}$ *and by* $\phi(n \to \infty) = \frac{1-\alpha}{A} \frac{\alpha+\eta(1-\alpha)}{\eta}$. *Simple algebra verifies that* $\phi(n \to \infty) > \phi(n=1)$ *as implied by the proposition.*

[22] Bratsiotis and Martins (1999, p.253) also find conflicting effects of centralization, and conclude that centralization is more likely to lead to lower wages and unemployment when the CB is sufficiently conservative.

[23] This is analogous to the strategic effect in Cukierman and Lippi (1999) and to the "internalization effect" in Guzzo and Velasco (1999).

stressed by Calmfors and Driffill (1988), and more recently by Cukierman and Lippi (1999).[24] This feature obviously depends on the particular structure of the model. However, the result in proposition 3 is consistent with empirical evidence suggesting that countries with a high degree of coordination in wage setting have lower unemployment (Nickell (1997), OECD (1997) and Nickell (1999)).

3.3 The effects of the degree of product substitutability on economic performance

The degree of product substitutability is characterized by the relative price elasticity, η, of the demand for goods. The larger this elasticity, the larger competition in product markets.

Proposition 4 *The wage premium, the rate of unemployment and inflation are all decreasing in the relative price-elasticity of the demand for goods, η.*

Proof. See Appendix. ■

The intuition for this result is simple. A larger η raises the size of the relative price effect generated by an increase in the nominal wage (this effect is contained in Z_u), and thus the employment loss.[25] More competitive product markets translate, via the derived demands for labor, into more competitive labor markets. Interestingly, interpreting the wage premium as a measure of labor market rigidity, it follows that higher market power in the goods market, as characterized by low values of η, induce rigidities in the labor market. This implication is consistent with findings reported in Nickell (1999). After considering several studies on the relation between wages and the degree of imperfect competition on product markets, Nickell concludes that there is evidence supporting the view that the real wage of unionized firms is

[24] Cukierman and Lippi (1999) and Guzzo and Velasco (1999) have noted that when decentralization, n, goes up there are two opposing effects on the wage premium: the "competition" effect, and the "strategic" effect. On one hand, since competition among labor of different unions goes up with their number the real wage goes down. On the other hand, since the impact of each union on the inflationary reaction of the CB is smaller when n is larger, unions become more aggressive and the real wage goes up.

[25] Note that even when the goods market approximates perfect competition ($\eta \to \infty$) the wage premium remains strictly positive. Even in this case, monopolistic unions manage to set wages above the competitive level by artificially restricting the supply of their members. This result is a consequence of the assumption that the typical firm can employ only the labor of its own union.

higher in sectors with more market power.[26]

3.4 Interactions between CBI, centralization of wage bargaining and product market competition

This section investigates how different degrees of centralization of wage bargaining and of product market competitiveness affect the marginal impact of CB conservativeness on the wage premium and unemployment. For simplicity the discussion is limited to the case in which unions are not averse to inflation ($B = 0$).

3.4.1 The effect of centralization of wage bargaining on the marginal impact of CB conservativeness on the wage premium

This subsection investigates how different degrees of centralization of wage bargaining affect the marginal impact of CB conservativeness on the wage premium and unemployment. For simplicity the discussion is limited to the case in which unions are not averse to inflation ($B = 0$).

When unions are not averse to inflation the marginal impact of CB conservativeness on the wage premium and unemployment is always negative. That is, $\frac{d\phi}{dI} < 0$. We analyze how a change in n affects $\frac{d\phi}{dI}$ by calculating, from equation (20), the cross impact on the wage premium of centralization and conservativeness ($\frac{d^2\phi}{dIdn}$). The sign of the resulting expression is given by:

$$sgn\left(\frac{d^2\phi}{dIdn}\right) = -sgn\left\{(1-\alpha)[\alpha+\eta(1-\alpha)] - (n-1)\eta\left[\frac{1}{I}+(1-\alpha)^2\right]\right\}$$

For given n, this expression is more likely to be negative the higher the level of I. Moreover, for low levels of centralization (n sufficiently large) the sign of $\frac{d^2\phi}{dIdn}$ tends to be positive, while for high levels of centralization (n relatively low) the sign tends to be negative.[27] Thus, the ability of a conservative CB to discourage high wage claims and high unemployment is par-

[26] Related evidence on the adverse effects of product and labor market rigidities on macroeconomic performance in European countries appears in Koedijk and Kremers (1996).

[27] More formally $\frac{d^2\phi}{dIdn} \gtreqless 0$ as $n \gtreqless 1 + \frac{(1-\alpha)[\alpha+\eta(1-\alpha)]}{\eta[\frac{1}{I}+(1-\alpha)^2]}$. Thus, $\frac{d^2\phi}{dIdn} < 0$ is more likely to hold for higher levels of I.

ticularly effective when centralization is at intermediate levels.[28] Interestingly, this implication of the theory is consistent with evidence on average unemployment rates for a group of OECD countries at various levels of centralization of wage bargaining and of CB conservativeness, reported in Table 1 of Soskice and Iversen (2000). The main empirical regularity in the table is that at intermediate levels of centralization the difference in average unemployment rates between high independence and low independence countries is negative and significant while at either low or high levels of centralization there is no significant difference in average unemployment rates between countries with high and low levels of CBI.[29]

3.4.2 The effect of product market competition on the impact of CBI on the wage premium

We turn next to investigate how the degree of product market competition, as characterized by η, affects the size of $\frac{d\phi}{dI} < 0$. It is straightforward to show that, for $B = 0$, $\frac{d^2\phi}{dId\eta} > 0$. Therefore, an increase in the level of competitiveness on product markets reduces the absolute value of the negative effect of CBI on the wage premium and unemployment, implying that more competition on product markets tends to reduce the benefits associated with CB conservativeness. Another way of stating the same result is that the beneficial effect of a more conservative CB for employment is larger the lower the level of competitiveness on product markets (a low η). Thus, scarce competition on product markets raises the desirability of having a highly conservative CB.

[28] This impact effect attains its maximal value when centralization is at the level $\left(\frac{1}{n}\right)^* = \left[1 + \frac{(1-\alpha)[\alpha+\eta(1-\alpha)]}{\eta[\frac{1}{I}+(1-\alpha)^2]}\right]^{-1}$. For the extreme cases of full centralization ($n = 1$) and full decentralization ($n \to \infty$) the wage premium is independent of CBI. Soskice and Iversen (2000) obtain a similar result in a somewhat more restricted framework.

[29] Holden (2003a) considers a model in which the degree of coordination of wage setting among unions is determined endogenously and argues that it is easier to sustain such coordination when the CB is relatively accommodative. His argument builds on the result that CB conservativeness is more effective in restraining unemployment when the labor market is not fully centralized. Thus, an accommodating CB generates a stronger incentive to coordinate wage setting, so as to achieve wage moderation and lower unemployment. In conjunction with the result in this subsection Holden's conclusion implies that the incentive to coordinate wage setting for this reason is stronger in relatively decentralized labor markets.

4 The socially optimal level of conservativeness

Ever since Rogoff (1985), the idea that it is socially optimal to appoint a central banker that is more conservative than society constituted a basic benchmark in discussions of the optimal design of monetary institutions. In the absence of shocks, Rogoff's framework implies that the optimal level of conservativeness is infinite. Thus, the CB should care only about price stability. By contrast, Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999) (as corrected by Lippi (2002)) and Lawler (2000) have recently shown that in the presence of an inflation averse monopoly union the socially optimal level of CB conservativeness is zero (the "populist CB" view in the sequel). Those frameworks abstract from the aggregate demand transmission channels of monetary policy. On the other hand, Bratsiotis and Martins (1999) and Soskice and Iversen (1998, 2000), while abstracting from the inflation fears of unions, incorporate the aggregate demand channel and conclude that a non accomodating CB brings about a better macroeconomic performance. Having established the relation between the relative aversion of unions to inflation/unemployment and the impact of conservativeness on one hand and the relation between conservativeness and accomodationon on the other, we are now in a position to shed some new light on those opposing views. Following Rogoff and others let the social loss function be

$$\Lambda = u^2 + S\ \pi^2 \tag{25}$$

where $S \in (0, \infty)$ represents society's relative aversion to inflation, that may generally differ from the relative inflation aversion of the CB, I.[30] The main issue then is the following: If society delegates the conduct of monetary policy to a central banker, what is the level of CB conservativeness (or inflation aversion) that is optimal for a society with relative inflation aversion S? Inserting the equilibrium expressions for u and π from equations (23) and (24) into equation (25) this problem is equivalent to the minimization of the following expression with respect to I,

$$\Lambda(I) = \left(\frac{\phi(I)}{1-\alpha}\right)^2 + S\left(\frac{\phi(I)}{(1-\alpha)^2 I}\right)^2 \tag{26}$$

[30] Woodford (1999) discusses the circumstances under which such a quadratic welfare function is a good approximation of welfare in a model that is explicitly based on utility.

where $\phi(I)$ is given by equation (20). Note that social losses depend on central bank conservativeness directly, as well as through the effect that conservativeness has on the wage premium, $\phi(I)$. When unions do not care about inflation ($B = 0$), the following holds:

Proposition 5 *: When $B = 0$ an ultra conservative central banker is socially optimal.*

Proof. See Appendix. ■

The intuition underlying the proposition is simple. When unions are averse only to unemployment, an extremely conservative CB has a maximal moderating effect on unions' real wage demands. This in turn implies that, under such a central banker, unemployment and inflation will be at their lowest levels. No matter how strong is the inflation aversion of society, it therefore pays to appoint an "ultra conservative" central banker.[31]

We turn next to the more general case where the relative inflation aversion of unions is **strictly positive** but moderate; i.e., $\frac{B}{A}$ is strictly positive but not too large. The following proposition provides some overly strong conditions for an ultra conservative CB to be socially optimal when there is more than one union.[32]

Proposition 6 *: (i) If*

$$\frac{B}{A} < Min\left\{S\left(1-\frac{\alpha}{2}\right), \frac{1}{2(1-\alpha)}\right\}$$

*the social optimum problem does **not** have an internal solution.*

(ii) If there is more than one union, the condition in part (i) is satisfied, and if

$$\frac{B}{A} < \frac{2-\alpha}{2(1-\alpha)}\sqrt{S}$$

an ultra conservative CB is socially optimal.

[31] Although monotonically decreasing in I, the wage premium remains positive when $I \longrightarrow \infty$. It is worth noting, at the risk of some repetition, that this analysis abstracts from the potential gains from stabilization policy.

[32] With a single inflation-averse union (i.e., $n = 1$ and $B > 0$), the wage-premium is equal to $\frac{(1-\alpha)^4 I^2}{(1-\alpha)^2 I^2 A + B}$, and the social optimum is attained by an ultra liberal central banker. This conclusion crucially depends on inflation aversion ($B > 0$). For the single union case, the net effect of a higher wage claim just reduces to costly inflation, and the more so the more liberal the CB.

Proof. See Appendix. ■

Proposition 6 states that if the inflation aversion of unions is sufficiently small in comparison to their aversion to unemployment an ultra conservative central banker maximizes social welfare. For the standard case in which the parameter α is equal to 2/3, the conditions in the proposition reduce to $\frac{B}{A} < \min\left\{\frac{2}{3}S, \frac{3}{2}, 2\sqrt{S}\right\}$. Since unions are likely to be relatively more concerned about unemployment than about inflation, this condition is likely to be satisfied in reality (see Calmfors (2001) for a discussion).

Thus, for the case of more than one union, an ultra conservative central banker is socially optimal unless $\frac{B}{A}$ is implausibly large.[33] It follows that the optimality of the populist CB is very likely to be the exception rather than the rule.[34] The root cause of the difference is that the populist CB view is derived within frameworks that abstract from the aggregate demand channel of monetary policy. As a consequence the deterring effects of contractionary monetary policies designed to reduce wage driven inflations are neglected. Since such contractionary policies reduce the demand for labor, unions moderate their wage demands mainly because of fear of unemployment among their members, rather than because of their inflationary fears. Bratsiotis and Martins (1999) and Soskice and Iversen (1998, 2000) recognize this effect but, since they abstract from the inflation fears of unions, their frameworks are not sufficient to settle the issue.[35]

To sum up, deterrence generally operates via two channels. A relatively liberal CB has a comparative advantage at deterring unions from setting high wages via their inflation aversion, while a relatively conservative CB has a comparative advantage in deterring them through their aversion to unemployment. This can be summarized more generally as follows

Proposition 7 *Deterrence of real wage claims by the CB is most effective when the relative*

[33] This conclusion is backed by numerical simulations in which social losses are minimized when I tends to infinity unless B is much larger than A.

[34] Guzzo and Velasco (1999) have claimed that a populist central banker is socially optimal at **all** levels of centralization of wage bargaining. But this is due to their implicit assumption that wages are contracted in real terms. As shown by Lippi (2002) (and recognized in Guzzo and Velasco (2002)) when wages are contracted in nominal terms the Guzzo and Velasco model implies, as do the other models, that a populist CB is socially optimal provided there is a **single monopoly** union.

[35] In a model with a CES production function in labor varieties Lippi (Forthcoming) shows that the effect of CB conservativeness on employment is ambiguous due to its opposite effects on output demand and on labor substituability. But, since his model does not feature a channel of monetary policy that operates via aggregate demand, it does not really capture the main deterring mechanism of Soskice and Iversen.

aversion of the CB to unemployment versus inflation is biased in a direction opposite to that of labor unions.

Propositions 5 and 6 can be viewed as particular cases of this general principle.

Before closing this section it is important to note that the preceding analysis is based on the presumption that the degree of indexation is exogenous. Liviatan (2002) has recently critisized the notion that unions will moderate their real wage demands, due to substantial inflationary fears, when a sufficiently populist CB is appointed. His argument is that the level of indexation in the economy reacts endogenously and positively to the the level of populism of the CB. Appointment of a highly liberal CB will induce unions to raise the degree of wage indexation, thus neutralizing the deterring effect of such a bank on their wage setting behavior. This is a further argument against the appointment of a populist CB and in favor of appointing its conservative counterpart.

5 Concluding remarks

This paper proposes a general equilibrium framework with endogenous monetary policy that characterizes the effects of CB conservativeness, product market differentiation, and the degree of centralization of wage bargaining on wages, employment and inflation. Unlike most of the literature on strategic monetary policy our framework features **both** aggregate supply and aggregate demand transmission channels of monetary policy.

Some of the main results follow. First, the degree of monetary accommodation in response to nominal wage inceases depends on CB conservativeness. The more conservative the CB the less accommodative it is. Second, a sufficiently conservative CB will **reduce** money growth in response to nominal wage inflation. This is consistent with econometric evidence, as well as with casual observations on countries like Germany under the highly conservative Bundesbank. Third, when unions' aversion to unemployment is sufficiently larger than their inflation aversion, an ultra conservative CB is socially optimal.[36] This result supports, within a richer and more realistic framework, the point of view of Bratsiotis and Martins (1999) and Soskice and Iversen

[36] This abstracts from the existence of shocks and stabilization policy.

(1998, 2000), rather than that of the "populist CB" view. Fourth, when unions do not care about inflation, CB conservativeness and unemployment are always negatively related. Fifth, the moderating marginal impact of CB conservativeness on unemployment is largest at intermediate levels of centralization of wage bargaining. This is consistent with evidence presented in Soskice and Iversen (2000). Sixth, the effectiveness of a conservative CB in reducing unemployment is higher the lower competition on product markets. Finally, the extent of both real and of nominal wage rigidities depends on the nature of monetary institutions. In particular, high CB conservativeness reduces downward real and nominal wage rigidity, making wages closer to their market clearing level. This is an instance of the Lucas critique.

From a methodological point of view, the paper integrates two recent strands of literature on labor markets and monetary policy. On one hand, the work of Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999) and Lawler (2000) builds on unions' "fear of inflation". These papers, as well as Lippi (Forthcoming) consider the interaction between CB's preferences and unions in a framework in which monetary policy affects the economy only via supply, while Bratsiotis and Martins (1999) and Soskice and Iversen (2000) consider frameworks in which policy affects the economy only via demand.

Our framework integrates all those elements and goes somewhat beyond. First, it features both supply and demand driven transmission channels of monetary policy. The Keynesian aggregate demand effect of monetary policy operates in spite of the fact that prices are flexible. In our framework the real effects of monetary institutions arise because of the conjunction of wage stickiness and a strategic interaction between large wage setters and the monetary authority. Second, since we consider both wage-setting and price-setting within the **same** framework it is possible to discuss the distinct roles of imperfections in the labor and in the goods markets, the interactions between those two types of imperfections and, finally, the relationship between these imperfections and the nature of monetary policymaking institutions. Third, the paper derives the reaction function of the CB endogenously from its employment and inflation objectives. This makes it possible to characterize the equilibrium relation between the money-supply rule and the degree of CB conservativeness.

The paper provides further support for the conservative CB paradigm, pioneered by

Rogoff (1985).[37] It sheds additional light on the recent debate regarding the optimal degree of CB conservativeness in the presence of non atomistic wage setters by showing that the "populist CB" result is a rather special extreme case.

We have limited our discussion to the case in which there are no stochastic shocks and the public is fully informed about the degree of conservativeness of the CB.[38] The framework of this paper can also be exploited to investigate situations in which a relatively conservative CB has not yet fully established its credentials. The latter case involves a familiar trade-off between current and future unemployment since, to establish credentials, a conservative CB has to be relatively contractionary in the present. We leave this and other extensions for future work.

6 Appendix

6.1 Derivation of equilibrium wages

Differentiating equation (16) with respect to the nominal wage of union i

$$\frac{dm}{dw_i} = \frac{1-\alpha(1-\alpha)I}{n\left[1+(1-\alpha)^2 I\right]} \tag{27}$$

where use has been made of the fact that $w = \frac{1}{n}w_i + \frac{n-1}{n}w_{-i}$. Differentiating (11) with respect to w_i and using the last relation yields:

$$\frac{dp}{dw_i} = (1-\alpha)\frac{dm}{dw_i} + \alpha\frac{dw}{dw_i} = \frac{1}{n\left[1+(1-\alpha)^2 I\right]}. \tag{28}$$

>From equation (10) one obtains

$$\frac{d(m-p)}{dw_i} = -\frac{\alpha}{(1-\alpha)}\frac{d(w-p)}{dw_i}$$

Differentiating (7) with respect to w_i and using the previous expression yields:

[37] However, rather than focussing on the tradeoff between stabilization policy and the inflation bias, the focus here (as well as in related papers with unionized labor markets) is on the effect of CB conservativeness on the level of real wages and through them on unemployment and inflation.

[38] The issue of stabilization policy in the presence of shocks is analysed in Bratsiotis and Martin (1999) and Coricelli et al. (2001) for the case in which unions are not inflation-averse.

$$\frac{d(p_{ij}-p_i)}{dw_i}=\frac{\alpha}{\alpha+\eta(1-\alpha)}\left[1-\frac{dp}{dw_i}-\frac{d(w-p)}{dw_i}\right]. \tag{29}$$

Using $w=\frac{1}{n}w_i+\frac{n-1}{n}w_{-i}$ and equation (28)

$$\frac{d(w-p)}{dw_i}=\frac{(1-\alpha)^2 I}{n\left[1+(1-\alpha)^2 I\right]}. \tag{30}$$

Substituting (28) and (30) into (29) and rearranging yields

$$\frac{d(p_{ij}-p)}{dw_i}=\left(\frac{n-1}{n}\right)\frac{\alpha}{\alpha+\eta(1-\alpha)} \tag{31}$$

Differentiating equation (10) with respect to w_i, using (30), and rearranging yields

$$\frac{d(m-p)}{dw_i}=\frac{-\alpha(1-\alpha)I}{n\left[1+(1-\alpha)^2 I\right]}. \tag{32}$$

Differentiating (18) with respect to w_i, using equations (31) and (32), and rearranging yields:

$$\frac{du_i}{dw_i}=\frac{1}{n}\left[\frac{\eta(n-1)}{\alpha+\eta(1-\alpha)}+\frac{(1-\alpha)I}{[1+(1-\alpha)^2 I]}\right]. \tag{33}$$

Using (28) and (33) in equation (19) the first order condition of union i can be rewritten as:

$$-Z_w+A\underbrace{\left\{l_0+\frac{1}{\alpha}\left[\eta(p_i-p)-(m-p)\right]\right\}}_{u_i}Z_u+B\,\pi\,(1-Z_w)=0 \tag{34}$$

where $Z_w \equiv 1-\frac{1}{n[1+(1-\alpha)^2 I]}$, $Z_u \equiv \left[\frac{\eta}{D}\frac{n-1}{n}+\frac{(1-\alpha)I}{n\,K}\right]$, $D \equiv [\alpha+\eta(1-\alpha)]$, and $K \equiv [1+(1-\alpha)^2 I]$.

We now show that the existence of a Nash equilibrium in wages requires symmetry in prices, that is: $p_i = p$. Given symmetry in prices, we then show that the Nash equilibrium in wages itself is *symmetric.* First, to show that price symmetry is necessary for the existence of a Nash equilibrium in wages, notice that a condition like (34) must simultaneously hold for each union i, with $i = 1, .., n$. These n conditions may differ, if at all, from one another *only* in the linear terms in $(p_i - p)$. The first order conditions for any two unions, s and q, imply, therefore, that $(p_s - p) = (p_q - p)$: the two unions first order conditions can be *simultaneously* satisfied if

and only if the monopolistically competitive firms set identical prices on their products. Since this is true for any two first order conditions it follows that $p_i = p$, for every $i = 1, .., n$. Using this result in equation (34) implies that the first order conditions of all unions are identical. Hence they all set the *same* nominal wage.

The reaction function of the CB in equation (16), the expression for the equilibrium price level in equation (11) and the typical union first order condition in equation (34) provide a system of three linear equations from which w, p and m can be solved. The solution for the wage premium is obtained, after a substantial amount of algebra, by using the first two equations in the last one and by using the expression for the competitive real wage.

6.2 Derivation of the competitive real wage w_r^c

The competitive real wage, w_r^c, is the wage level that equates labor supply and labor demand, or

$$\int_0^1 l_0 \, dj = \int_0^1 l_{ij}^d \, dj.$$

When the labor market is competitive all firms face the same wage and set, therefore, the same price. Hence the derived demand for labor (equation (8)) reduces to

$$l_{ij}^d = \frac{1}{\alpha}(m - p)$$

Using the last expression in the previous one, the labor market clearing condition can be rewritten as:

$$l_0 = \int_0^1 \left[\frac{1}{\alpha}(m - p)\right] dj = \frac{1}{\alpha}(m - p).$$

Using equation (10), which relates real money balances to the average real wage level, and rearranging we obtain the solution for the competitive wage:

$$w_r^c = -(1 - \alpha)l_0 + \frac{1 - \alpha}{\alpha}\rho.$$

6.3 Proof of Proposition 1

Differentiating equation (20) totally with respect to I and rearranging, it can be shown that

$$Sgn\left\{\frac{d\phi}{dI}\right\} = Sgn\left\{\left[(n-1)+2n(1-\alpha)^2 I\right]B - \frac{\alpha(1-\alpha)^2(n-1)I^2}{\alpha+\eta(1-\alpha)}A\right\}.$$

This expression is negative and the wage premium is decreasing in I if and only if $\frac{B}{A} < \left(\frac{B}{A}\right)_c$. Given this condition, equations (23) and (24) imply that unemployment and inflation are also decreasing functions of I. QED

6.4 Proof of Proposition 2

Proposition 1 implies that, given $\frac{B}{A}$ there is a value of I, that we label I_c, at which the critical value $\left(\frac{B}{A}\right)_c$ which depends on I, is equal to $\frac{B}{A}$. The equality $\frac{B}{A} = \left(\frac{B}{A}\right)_c$ is equivalent to the following quadratic equation in I:

$$Q(I) \equiv \alpha(1-\alpha)^2(n-1)I^2 - 2(1-\alpha)^2 Dn\frac{B}{A}I - (n-1)D\frac{B}{A}.$$

Proposition 1 implies that $\frac{d\phi}{dI}$ is negative, positive or zero depending on whether $Q(I)$ is positive, negative or zero. The polynomial $Q(I)$ has two roots, one of which is positive and the other negative. Since the economics of the problem limits the variation in I to the non negative orthant, I_c is given by the positive root. Since the coefficient of the square term is positive $Q(I)$ possesses a minimum and cuts, therefore, the horizontal axis at the positive root from below. For $I \geq 0$, it follows that $Q(I) > 0$ and $\frac{d\phi}{dI} < 0$ to the right of I_c; $Q(I) < 0$ and $\frac{d\phi}{dI} > 0$ to the left of I_c; and $Q(I) = \frac{d\phi}{dI} = 0$ at I_c. The value of I_c is obtained by solving for the positive root of the quadratic $Q(I)$. QED

6.5 Proof of Proposition 3

By totally differentiating the equilibrium expression for the wage premium in equation (20) with respect to n and rearranging, one obtains that $Sgn\left\{\frac{d\phi}{dn}\right\} = Sgn\left\{\alpha\right\} > 0$. Since α is positive it follows that the wage premium is increasing in the number of unions, n. In addition, since, from

equations (23) and (24), unemployment and inflation are positively related to ϕ it follows that they too rise with decentralization of bargaining in the labor market. QED

6.6 Proof of Proposition 4

Examination of equation (20) reveals that the wage premium depends on η only via Z_u. It is easy to see, from equation (22) that Z_u is increasing in η, and that the wage premium is, therefore, decreasing in η. The results for inflation and unemployment follow directly from equations (23) and (24). QED

6.7 Proof of Proposition 5

Proposition 1 implies that, for $B = 0$, the wage premium is a decreasing function of I in the entire economically meaningful range of I. It follows that social losses are minimized when the CB is ultra conservative ($I \to \infty$). QED

6.8 Proof of Proposition 6

Part (i). We start by showing that, when $\frac{B}{A} < \frac{S}{2}\left(\frac{\alpha+\eta(1-\alpha)n}{\alpha+\eta(1-\alpha)}\right)$ and $\frac{B}{A} < \frac{\eta(n-1)^2}{n(1-\alpha)[\alpha+\eta(1-\alpha)]}$ hold simultaneously, the social optimum problem does not have an internal solution. We first differentiate equation (26) with respect to I:

$$\frac{d\Lambda(I)}{dI} = \frac{2\phi(I)}{(1-\alpha)^2}\left[\left(1+\frac{S}{(1-\alpha)^2I^2}\right)\frac{d\phi(I)}{dI} - \frac{S}{(1-\alpha)^2I^3}\phi(I)\right]. \tag{35}$$

If there is an internal extremum this expression equals zero. Thus, for an internal solution to exist, the following must hold

$$\frac{d\phi(I)}{dI}\frac{I}{\phi(I)} = \frac{S}{(1-\alpha)^2I^2+S}. \tag{36}$$

Condition (36) in conjunction with the derivative of the wage premium with respect to I (obtained from equation (20)) generates, after some algebra, the following equation:

$$\Psi(I) \equiv K_3I^3 + K_2I^2 + K_1I + K_0 = 0 \tag{37}$$

where

$$K_3 \equiv \frac{-\alpha(1-\alpha)^3(n-1)}{D}, \tag{38}$$

$$K_2 \equiv (1-\alpha)^3 n \left(2\frac{B}{A} - S\frac{\eta n(1-\alpha)+\alpha}{D}\right), \tag{39}$$

$$K_1 \equiv (1-\alpha)(n-1)\left(\frac{B}{A} - 2S\frac{\eta n(1-\alpha)+\alpha}{D}\right), \tag{40}$$

$$K_0 \equiv S\left(\frac{B}{A}(1-\alpha)n - \frac{\eta(n-1)^2}{D}\right). \tag{41}$$

Since $I \geq 0$, the equation $\Psi(I) = 0$ cannot be satisfied whenever the coefficients K_0, K_1, K_2, K_3 are all negative. In this case, an internal solution ($0 < I^* < \infty$) to the social optimum problem does not exist. The proof of Part (i) is completed by noting that when the conditions

$$\frac{B}{A} < \frac{S}{2}\left(\frac{\alpha+\eta(1-\alpha)n}{\alpha+\eta(1-\alpha)}\right) \tag{42}$$

and

$$\frac{B}{A} < \frac{\eta(n-1)^2}{n(1-\alpha)[\alpha+\eta(1-\alpha)]} \tag{43}$$

hold simultaneously the constants K_0, K_1, K_2, K_3 are all negative. Since the bounds on the right hand side of these conditions are monotonically increasing in both η and n, they attain their smallest values when η and n are at their lowest permissible values which are 1 and 2 respectively. If $\frac{B}{A}$ is smaller than these minimal upper bounds, it is *a fortiori* lower than the upper bounds at higher values of η and n. Inserting the condition $\eta = 1$ and $n = 2$ into the upper bounds yields the conditions reported in Part (i) of the proposition.

Part (ii): Under the conditions stated in Part (i) of the proposition, the socially optimal level of conservativeness is either zero or infinity. To characterize the set of circumstances under which either of those two extreme types is socially optimal we evaluate the values of inflation, of unemployment and of social losses in equation (26) for each of them. Under an ultra liberal

central banker the wage premium and unemployment are zero and inflation and social losses are given respectively by

$$\pi = \frac{n-1}{B} \tag{44}$$

and

$$\Lambda(0) = S\left(\frac{n-1}{B}\right)^2. \tag{45}$$

Thus, as in Cukierman and Lippi (1999) and Lippi (2000), an ultra liberal CB totally eliminates unemployment by riding on the inflationary fears of unions. But it also totally eliminates inflation only in the extreme case in which there is a single monopoly union. Hence in the case of a monopoly union an ultra liberal CB is socially optimal.

Under an ultra conservative central banker inflation is zero and unemployment and social welfare are given respectively by

$$u = \frac{1-\alpha}{A}\ \frac{[\alpha+\eta(1-\alpha)]\,n}{\alpha+\eta(1-\alpha)n} \tag{46}$$

and

$$\underset{I\to\infty}{Lim}\Lambda(I) = \left(\frac{1-\alpha}{A}\ \ \frac{[\alpha+\eta(1-\alpha)]\,n}{\alpha+\eta(1-\alpha)n}\right)^2. \tag{47}$$

An ultra liberal or an ultra conservative CB is socially optimal depending on whether $\Lambda(0)$ is smaller or larger than $\underset{I\to\infty}{Lim}\Lambda(I)$. Not surprisingly the welfare ranking of those two cases depends on society's relative inflation aversion. The socially optimal level of conservativeness will be infinity if and only if $\underset{I\to\infty}{Lim}\Lambda(I) < \Lambda(0)$: equations (45) and (47) imply that this condition is equivalent to the condition $\frac{B}{A} < \left(\frac{\alpha+(1-\alpha)\eta n}{(1-\alpha)(\alpha+(1-\alpha)\eta)}\right)\left(\frac{n-1}{n}\right)\sqrt{S}$. Since the bound on the right hand side is increasing in both η and n, it will attain its smallest value when $\eta = 1$ and $n = 2$, yielding the condition $\frac{B}{A} < \frac{2-\alpha}{2(1-\alpha)}\sqrt{S}$ reported in Part (ii) of the proposition.

Thus, provided that the conditions in the proposition are satisfied, the social welfare function has no internal minimum, and an ultra conservative CB is optimal. QED

7 References

Berghahn V. and K. Detlev (1987), **Industrial Relations in West Germany**, Oxford: Berg.

Blanchard O. and N. Kiyotaki (1987), Monopolistic Competition and the Effects of Aggregate Demand", **American Economic Review**, 77, September, 647-666.

Blanchard O. and S. Fischer (1989), **Lectures in Macroeconomics**, The MIT Press, Cambridge, MA.

Bratsiotis G. and C. Martin (1999), "Stabilization, Policy Targets and Unemployment in Imperfectly Competitive Economies", **Scandinavian Journal of Economics**, 101, 241-256.

Calmfors L. (2001), "Wages and Wage-Bargaining Institutions in the EMU - A Survey of the Issues", **Empirica**, 28, 325-351.

Clarida R., J. Galì, and M. Gertler (1999), "The Science of Monetary Policy: A New-Keynesian Perspective", **Journal of Economic Literature**, 37, 1661-1707.

Coricelli F., A. Cukierman and A. Dalmazzo (2001), " Economic Performance and Stabilization Policy in a Monetary Union with Imperfect Labor and Goods' Markets ", Forthcoming in: Sinn H.W., M. Widgren and M. Kothenburger (eds.), Issues of **Monetary Integration in Europe**, The MIT Press. Available on the web at: http://www.tau.ac.il/~alexcuk/pdf/ccdmu5-04a.pdf

Cubitt R. (1992), "Monetary Policy Games and Private Sector Precommitment", **Oxford Economic Papers**, 44, 513-530.

Cukierman A.and F. Lippi (1999), "Central Bank Independence, Centralization of Wage Bargaining, Inflation and Unemployment - Theory and Some Evidence", **European Economic Review**, 43, 1395-1434.

Cukierman A. and F. Lippi (2001), "Labour Markets and Monetary Unions: A Strategic Analysis", **Economic Journal**, 111, 541-565.

Cukierman A., P. Rodriguez and S. Webb (1998), "Central Bank Autonomy and Exchange Rate Regimes-Their Effects on Monetary Accommodation and Activism", in S. Eijffinger H. Huizinga (eds.), **Positive Political Economy-Theory and Evidence**, Cambridge University Press, Cambridge, UK and NY.

Dixit A. and J. Stiglitz (1977), "Monopolistic Competition and Optimum Product Di-

versity", **American Economic Review**, 67, 297-308.

Gali J., M. Gertler and D. Lopez- Salido (2001), "European Inflation Dynamics", **European Economic Review**, 45, 1237-1270.

Guzzo V. and A. Velasco (1999), "The Case for a Populist Central Bank", **European Economic Review**, 43, 1317-1344.

Guzzo V. and A. Velasco (2002), "Revisiting the Case for a Populist Central Banker: A Comment", **European Economic Review,** 46, 613-621.

Gylfason T. and A. Lindbeck (1994), "The Interaction of Monetary Policy and Wages", **Public Choice**, 79, 33-46.

Hall P. A. (1994), "Central Bank Independence and Coordinated Wage Bargaining: Their Interaction in Germany and Europe", **German Politics and Society**, Issue 31, 1-23.

Hall P. A. and R. J. Franzese Jr. (1998), "Mixed Signals: Central Bank Independence, Coordinated Wage Bargaining, and European Monetary Union", **International Organization**, 52, 3, 505-535.

Holden S. (2003a), "Monetary Regimes and the Coordination of Wage Setting", Forthcoming: **European Economic Review**. Available on the web at: http://folk.uio.no/sholden/coor-jan03.pdf

Holden S. (2003b), "Wage-setting under Different Monetary Regimes", **Economica**, 70, 251-265.

Jensen H. (1997), "Monetary Policy Cooperation May Not Be Counterproductive", **Scandinavian Journal of Economics**, 99, 1, 73-80.

Jerger J. (2002), "How Strong is the case for a Populist Central Banker? A Note", **European Economic Review**, 46, 623-632.

Koedijk K. and J. Kremer (1996), "Market Opening, Regulation and Growth in Europe", **Economic Policy**, 443-460.

Lawler P. (2000), "Centralised Wage Setting, Inflation Contracts, and the Optimal Choice of Central Banker", **Economic Journal**, 110, 559-575.

Lippi F. (2002) "Revisiting the Case for a Populist Central Banker", **European Economic Review,** 46, 601-612.

Lippi F. (Forthcoming) "Strategic Monetary Policy with Non-Atomistic Wage Setters",

December 2002 version; Forthcoming: **Review of Economic Studies.**

Liviatan N. (2002) "The Populist Central Bank and Wage Indexation", Manuscript, Bank of Israel.

Mishkin F. (2001) **The Economics of Money, Banking, and Financial Markets**, Addison Wesley, Boston, San Francisco, New York.

Nickell S. (1997), "Unemployment and Labor Market Rigidities: Europe versus North America", **Journal of Economic Perspectives**, 11, No. 3, 55-74.

Nickell S. (1999), "Product Markets and Labour Markets", **Labour Economics**, 6, 1-20.

OECD (1997), **Employment Outlook**, July, Paris.

Oswald A.J. (1982), "The Microeconomic Theory of Trade Union", **Economic Journal**, 92, 576-595.

Rogoff K. (1985), "The Optimal Degree of Commitment to a Monetary Target", **Quarterly Journal of Economics**, 100, 1169-1190.

Saint-Paul, G. (2000), **The Political Economy of Labour Market Institutions,** Oxford University Press, Oxford ; New York.

Skott P. (1997), "Stagflationary Consequences of Prudent Monetary Policy in a Unionized Economy", **Oxford Economic Papers**, 49, 609-622.

Soskice D. and T. Iversen (1998), "Multiple Wage-Bargaining Systems in the Single European Currency Area", **Oxford Review of Economic Policy**, 14, 110-124.

Soskice D. and T. Iversen (2000), "The Non Neutrality of Monetary Policy with Large Price or Wage Setters", **Quarterly Journal of Economics,** 115, 265-284**.**

Stigler G.J. and J.K. Kindhal (1970), **The Behavior of Industrial Prices**, Columbia University Press for the NBER, New-York.

Streeck W. (1994), "Pay Restraint Without Income Policy: Institutionalized Monetarism and Industrial Unionism in Germany" in R. Dore, R. Boyer and Z. Marn (eds.), **The Return of Income Policy**, Pinter, London.

Vartiainen J. (2002), "Relative Prices in Monetary Union and Floating", **Scandinavian Journal of Economics**, 104, 277-287.

Woodford M. (1999), "Inflation Stabilization and Welfare", Princeton University.