

Monetary Institutions, Monetary Union and Unionized Labor Markets - Some Recent Developments*

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1 Introduction

This paper is a selective survey of recent developments regarding the strategic interaction between labor unions and the monetary authority. Since Rogoff (1985) influential work a basic tenet of the literature on strategic monetary policy with competitive labor markets is that, abstracting from stabilization policy, the level of central bank conservativeness (CBC) affects inflation but not real variables. An important general message of the burgeoning literature on unionized labor markets and monetary institutions is that, when wage settlements are centralized within a small or moderate number of unions, CBC affects inflation **as well as** real variables like unemployment, output and real wages. This insight and the analytical frameworks that underly it are particularly relevant for European economies in which the fraction of the labor force covered by collective agreements is large and in which wage bargaining institutions are frequently rather centralized.

Most of the recent literature on the strategic interaction between the central bank (CB) and unions shares two basic presumptions. First, nominal wages are contractually fixed for a certain period of time to which I shall refer as the 'contract period'. Second, monetary

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policy and prices can be adjusted during the contract period. Casual observation supports both presumptions. Union nominal wage are normally fixed for at least one year while prices and the money supply are usually adjusted at frequencies that are higher than one year. Those presumptions lead to the formulation of simple game theoretic models in which unions move first and set nominal wages while the CB moves second and chooses, depending on the model, the rate of inflation or the money supply. Third, union management likes higher real wages for its members but dislikes unemployment among them. Some of the recent literature also assumes that unions are averse to inflation.¹ This is motivated by the observation that in many cases the pensions of union workers are not indexed and that union members, like other individuals, generally dislike inflation. Fourth, as in the early Kydland and Prescott (1997) and Barro and Gordon (1983) (KPBG in the sequel) literature and its spin-offs, the CB is assumed to possess a loss function that is quadratic in both inflation and unemployment.

For the sake of simplicity a good part of the recent literature investigates the strategic interaction between the labor market and the CB for the extreme case of a single, all encompassing, monopoly union. The more recent literature generally considers the case of several unions.² Following the lead of the KPBG type models much of the literature on unions and the CB assumes that the CB directly controls the rate of inflation.³ More recent literature recognizes that prices are set by firms and that the policy instrument of the monetary authority is the money supply. A basic consequence of this difference in modeling choices is that in the first group of models monetary policy affects the economy only via supply side channels whereas in the second group it affects it also through demand side channels.⁴

This difference in modeling strategy leads to diametrically opposed conclusions about the real effects of CBC on the economy. In particular papers which assume that the CB directly controls inflation and that unions are averse to inflation, conclude that by alleviating the infla-

¹A non exhaustive list includes Yashiv (1989), Cubitt (1992, 1995), Agell and Ysander (1993), Gylfason and Lindbeck (1994), Skott (1997), Jensen (1997), Gruner and Hefeker (1999), Cukierman and Lippi (1999, 2001), Guzzo and Velasco (1999) and Lawler (2000).

²Papers by Cubitt (1992, 1995), Gylfason and Lindbeck (1994), Jensen (1997), Gruner and Hefeker (1999), and Lawler (2000) represent the labor market by a single monopoly union. Papers by Bleaney (1996), Forteza (1998), Skott (1997), Cukierman and Lippi (1999, 2001), Guzzo and Velasco (1999) consider the case of many unions.

³Except for Cubitt (1992, 1995) all the papers mentioned in the previous footnote adopt this assumption.

⁴Papers by Cubitt (1992, 1995) Soskice and Iversen (1998, 2000), Bratsiotis and Martin (1999), Holden (2000) and Coricelli, Cukierman and Dalmazzo (2000, 2001) fall into the second class of models.

tionary 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 unemployment (Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999, 2002), Lawler (2000) and Lippi (2002)). On the other hand work by Soskice and Iversen (1998, 2000) which abstracts from unions' inflation aversion and postulates that the monetary authority controls the money supply concludes 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 Since the frameworks used by the two groups of papers differ in structure and each group abstracts from some of the factors included in the analysis of the other group it is hard to reach a verdict on this controversy from these papers alone.

Coricelli, Cukierman and Dalmazzo (2000) propose a framework that embeds these different mechanisms within a **unified** framework making it possible to identify the conditions under which either one dominates. This framework features both supply side and demand side transmission channels of monetary policy. They find that, for realistic values of the relative aversion of unions to inflation and to unemployment, higher CBC reduces the bargaining power of unions and leads to lower values of unemployment, real wages and inflation. The main features of this framework are as follows. Prices and wages are set, respectively, by monopolistically competitive firms and by labor unions. Prices are fully flexible and wages are contractually fixed. The CB affects the price level and employment **indirectly** via its choice of money supply. The game now has a third stage in which firms set prices so as to maximize their real profits. This is preceded by the choice of money supply in the second stage and by the choice of nominal wages in the first stage.

The creation, at the beginning of 1999, of the European Monetary Union (EMU) and of the European Central Bank (ECB) altered the strategic interaction between the monetary authority and labor unions in the EMU area. Prior to the creation of the ECB labor unions in each country interacted only with their own national CB. In some countries like Germany the CB was setting monetary policy so as to attain its preferred level of domestic objectives.

In some other countries like Austria and Belgium, the CB conducted monetary policy so as to maintain a fixed parity with the German Mark, importing the Bundesbank monetary policy. After the creation of EMU the strategic interaction between labor unions and the CB obviously changed. In particular, each labor union became a smaller player relatively to the CB of the monetary union. For labor unions of countries whose CB previously conducted an independent monetary policy, national monetary policy was replaced by that of the ECB. For labor unions of countries whose CB was previously pegging to the D-Mark the monetary policy of the ECB replaced the peg. In addition, for some of the countries involved, the level of CBC went up while for other countries, like Germany and its monetary satellites, CBC went down. Some of the conceptual frameworks mentioned above have recently been adapted to investigate the long run macroeconomic consequences of these changes in monetary institutions. Various aspects of those major institutional changes are analysed in Gruner and Hefeker (1999), Sibert and Sutherland (2000), Cukierman and Lippi (2001) and Coricelli, Cukierman and Dalmazzo (2001). A broad survey of the issues and implications for the future appear in Calmfors (2001b).

The organization of the paper follows. Section 2 reviews baseline models of CB - labor union interaction in which the CB controls inflation directly. Section 3 reviews models of CB - labor union interaction in which the CB controls the money supply and the price level is determined by the individual pricing decisions of monopolistically competitive firms. An important difference between those two families of models is that in the first group monetary policy affects the economy only via supply. By contrast in the second group monetary policy impacts the economy through **both** supply and demand channels. Section 4 discusses the recent controversy regarding whether, in the presence of large unions, the CB should be more, or less, inflation averse than society. It critically reviews the notion (discovered independently by Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999) and Lawler (2000)) that a populist CB is socially desirable and contrasts it with the view that a non accommodating CB is socially desirable (due to Soskice and Iversen (1998, 2000)). Section 5 reviews recent literature on the long run macroeconomic consequences of the shift from national monetary policies to a monetary union (MU). This is followed by concluding remarks.

2 A base line model: CB - labor unions' interaction when the CB directly controls inflation

The objective of this section is to illustrate the basic forces operating in the presence of a, relatively simple, strategic interaction between unions and the CB in a precise, but not overly specific manner.⁵ Although this requires a concrete model many of the conclusions transcend the structure of the particular model, and when this is not the case the model provides a benchmark for qualification of the conclusions.

The economy consists of n independent unions and of a CB whose degree of CBC is characterized by a parameter I . The typical union likes high real wages and low unemployment for its members and also dislikes inflation to some extent. This is captured by the loss function:

$$\Omega_j \equiv -2w_{rj} + Au_j^2 + B\pi^2 \quad (1)$$

where u_j is the rate of unemployment among members of union j , $\pi \equiv p - p_{-1}$ is the rate of inflation (defined by the difference in the log of the price level) and A and B are positive parameters. The first two arguments reflect the union's sectoral interest and are conventional in the theory of trade unions' behavior.⁶ The third one reflects the union's aversion to inflation.

The CB is concerned with aggregate unemployment (u) and price stability. More precisely, the objective of the CB is to minimize the following loss function:

$$\Gamma \equiv u^2 + I\pi^2 \quad (2)$$

where I is a measure of the relative inflation aversion of the CB. This parameter characterizes the level of CB conservativeness.(CBC). The basic institutional parameters highlighted by this

⁵This section draws on Cukierman and Lippi (1999). For proofs and additional detail the reader is referred to that paper.

⁶Those two arguments are standard in the theory of labor union behavior (Oswald (1982)). They can also be justified by political economy considerations internal to the union of the type discussed in St-Paul (2000).

framework are CBC as proxied by the parameter, I , and the degree of centralization of wage bargaining (CWB) characterized by $1/n$.

2.1 The labor market

Total labor supply in the economy is L . All labor is unionized and is evenly distributed over the n unions. Although the labor of any given union can be usefully employed in all industries it is not perfectly substitutable for the labor of other unions. The notion underlying this specification is that labor is generally differentiated. Labor of a given union is supplied completely inelastically and is mobile across industries. The demand for the labor of workers in union j is given by:

$$L_j^d = \left[\frac{a}{n}(d - w_{rj}) - \gamma(w_{rj} - \bar{w}_r) \right] L \quad (3)$$

where L_j^d is demand for the labor of that union, w_{rj} is the (logarithm) of the real wage obtained by its members, $\bar{w}_r \equiv \sum_{j=1}^n \frac{w_{rj}}{n}$ is the (arithmetic) mean of w_{rj} over all unions in the economy and d , a and γ are positive parameters. This demand function states that the share (in total labor force) of labor demand facing union j is decreasing in its own real wage and increasing in the average real wage in the economy. This demand emanates, in general, from all industries although the demand for the labor of a particular union may be dominated by the demands of a smaller number of industries. The specification of demand presumes that each worker is affiliated with only one union. Summing over unions, aggregate demand for labor in the economy is given by:

$$L^d \equiv \sum_{j=1}^n L_j^d = a(d - \bar{w}_r)L . \quad (4)$$

Equation (4) states that aggregate demand for labor depends (negatively) **only** on the **average** real wage \bar{w}_r . In particular aggregate demand for labor **does not** depend on the number of unions in the economy. Equation (3) implies that any union that sets its real wage equal to the average real wage in the economy obtains $1/n$ of aggregate labor demand for its

members. When it sets the real wage above (below) the mean wage its total share of aggregate demand is lower (higher) than $1/n$. But since labor is differentiated deviations of the real wage of a particular union from the economy wide average do not induce a total loss of demand or an infinite demand. For a given number of unions the parameter γ measures the degree of substitutability between the labor of different unions.

Equation (3) implies that the absolute value of the elasticity of labor demand facing union j , η_j , with respect to the (level of the) real wage set by the union is:

$$\eta_j = \frac{a + \gamma(n - 1)}{a(d - w_{rj}) - n\gamma(w_{rj} - \bar{w}_r)}. \quad (5)$$

This elasticity is increasing with the degree of decentralization of wage bargaining as measured by n provided w_{rj} does not deviate too much, in an upwardly direction, from the mean real wage.⁷ Thus, equation (3) implies that, although **total** labor demand does not depend on the degree of centralization of wage bargaining, the extent of wage competition among unions is larger when the labor force is spread over a larger number of bargaining units. This is the competition effect of more decentralization discussed by Calmfors and Driffill (1988) and Calmfors (1993).

2.2 Equilibrium

The strategic interaction between labor unions and the CB is framed as a two-stage game solved by backward induction. In the second stage, the CB chooses inflation, taking the nominal wages previously set by all unions as given, so as to minimize its loss function. In the first stage each union chooses its nominal wage rate so as to maximize its objectives, taking the nominal wage chosen by all other unions and the subsequent central bank reaction as given. Labor unions are thus Stackelberg leaders vis a vis the CB. The solution for the reaction function of the CB is

$$\pi = \frac{a^2}{a^2 + I}(\bar{\phi} + E\pi), \quad \bar{\phi} \equiv \bar{w}_r - w_r^c. \quad (6)$$

⁷Details appear in footnote 14 of Cukierman and Lippi (1999).

where w_r^c is the competitive (identical across labor types or unions) real wage rate and $\bar{\phi}$ is the average real wage premium in excess of the competitive benchmark. The CB reaction function implies that the CB partially accommodates the wage premium as well as expected inflation. In particular, the more militant are unions on average (the higher $\bar{\phi}$), the higher is the rate of inflation produced by the CB. For given values of expected inflation and of unions' militancy the extent of accommodation is larger the higher is the response of aggregate labor demand to the average real wage, α , and the lower the conservativeness of the CB, I .

Minimization with respect to the **nominal** wage, by each union, of the loss function in equation (1), taking into consideration the reaction of the CB in equation (6), leads to the following solution for the average real wage premium⁸

$$\bar{\phi} = \frac{Z_w}{a \{AZ_u + B\frac{a}{I}(1 - Z_w)\}} = \phi_j, \quad \forall j's. \quad (7)$$

where

$$Z_w \equiv 1 - \frac{d\pi}{dw_j} = 1 - \frac{a^2}{(a^2 + I)n}, \quad Z_u \equiv aZ_w + \gamma(n - 1), \quad j = 1, \dots, n. \quad (8)$$

This is also the wage premium of each individual union since the problem is symmetric. Since, from equation (8) $1 > Z_w > 0$, the real wage premium is always positive reflecting the market power of unions. Z_w is the elasticity of a single union real wage with respect to its nominal wage taking into consideration the reaction of the CB to the union's nominal wage choice. Since it is a measure of the overall effectiveness of changes in the nominal wage in bringing about changes in the union's real wage I refer to it as an "overall elasticity". For finite values of CB conservativeness and of the number of unions this elasticity is positive but smaller than one. This implies that in order to raise its real wage by one percent the union has to raise its nominal wage rate by more than one percent. Z_u is the marginal impact of an increase in

⁸In solving this problem each union takes the **nominal** wages of other unions as given. Thus each union plays Nash with the other unions and acts as a Stackelberg leader with respect to the CB.

the union's nominal wage on the rate of unemployment among its members.⁹ It is composed of two terms. The first, aZ_u , reflects the direct impact of an increase in the real wage of the union on unemployment among its members. The second, $\gamma(n - 1)$, is a substitution effect in labor demand. It reflects the impact of a decrease in the competitiveness of the union's labor when its relative wage goes up. The impact of this competition effect on unemployment among the union's members is larger the larger the substitution parameter, γ , and the larger the number of unions, n .

2.3 Factors affecting unions' bargaining power

The effective bargaining power of unions is conveniently summarized by the equilibrium expression for the wage premium in equation (7). The wage premium is lower, and employment higher, the higher the parameters A and B that characterize unions' aversion to unemployment and inflation respectively. The higher A , the more unions care about unemployment among their members, which directly leads them to set lower real wages. The higher B , the more averse are unions to the inflationary response of the CB to the increase in unemployment triggered by their wage demands. Hence high aversion to either unemployment or inflation on the part of unions decreases their bargaining power and moderates their wage demands. The larger the degree of substitutability between different kinds of labor as measured by the parameter γ , the lower the bargaining power of unions and the lower, therefore, the wage premium.

It is easy to check, from equation (7), that, other things the same, the wage premium is an increasing function of the elasticity, Z_w . The reason is that the marginal benefit to the union in terms of the real wage is higher, and the marginal cost in terms of inflation is lower, when Z_w is higher. On the other hand, given Z_w , the wage premium is lower the higher the elasticity Z_u . The reason, of course, is that the higher this elasticity, the higher the overall impact of an increase in the union's nominal wage on unemployment among its members.

The expression for Z_w in equation (8) reveals that the overall elasticity of a typical union's real wage with respect to its nominal counterpart is lower the smaller the number of unions and the more liberal is the CB (the lower I). The positive effect of n on real wages through Z_w

⁹It is also the overall elasticity of labor demand facing the union with respect to the union's nominal wage.

reflects the strategic effect of a more decentralized labor market. At lower levels of CWB each union internalizes a smaller portion of the inflationary response of the CB. As a consequence the moderating effect, on real wages, of the central bank's expected inflationary reaction is weaker. This effect also appears in Guzzo and Velasco (1999) who refer to it as the "internalization" effect. At first blush it would therefore seem that the wage premium is lower the smaller n and the more liberal the CB. But this neglects the fact that the wage premium also depends on n through the elasticity, Z_u , and that this elasticity is larger, the larger the number of unions. The positive relation between Z_u and n reflects the competition effect of a more decentralized system of wage bargaining. Notice that the marginal impact of an increase in the union's nominal wage on the rate of unemployment among its members is independent of CBC, I .

Depending on parameter values, and on the structure of the economy, the competition or internalization effect may dominate over, parts of or over, the entire range of n . In the model of Cukierman and Lippi (1999) those two offsetting effects produce a Calmfors-Driffill relation between the wage premium and the degree of CWB provided the inflation aversion of unions is larger than some threshold. The Calmfors-Driffill hypothesis maintains that at high levels of CWB the internalization or strategic effect dominates; at low levels of centralization the competition effect dominates, and at intermediate levels of centralization those effects roughly offset each other. As a consequence the wage premium attains a maximum at intermediate levels of CWB (Calmfors and Driffill (1988) and Calmfors (1993)). In the Guzzo and Velasco (1999) model which starts from individual utility and a Dixit-Stiglitz production function, the interaction between the competition and the internalization effect produces a reverse Calmfors-Driffill relation between the real wage and CWB. An important general implication of the recent literature is that the position and shape of the Calmfors-Driffill relation depends on CBC.

2.3.1 CBC and unions' bargaining power

A central implication of models with inflation averse unions in which the CB directly controls inflation is that a more conservative CB raises the bargaining power of unions and with it, the wage premium. The mechanism responsible for this result is as follows. The more conservative the CB, the less it inflates in response to an increase in the nominal wage of an individual union. As a consequence, for a given increase in its nominal wage, the union gains more in terms of

real wage and sustains a lower penalty in terms of inflation. Both factors push the union to set a higher real wage. This mechanism operates in all the models with inflation averse unions independently of whether they feature a single monopoly union or several unions.

But in the case of several unions there is an additional factor that operates in the same direction even if unions are indifferent to inflation (i.e. $B = 0$). In this case the basic tradeoff faced by the individual union is between a higher wage and a lower level of competitiveness that leads to more unemployment among its members. At higher levels of CBC the marginal benefit of a higher nominal wage in terms of the real wage is higher since the elasticity, Z_w , is higher. But the marginal cost of this action, which depends on the **relative** wage of the union is unaltered by CBC since, given nominal wages, relative wages are the same for all inflation rates. Hence, at higher levels of CBC the marginal benefit in terms of real wages is higher in comparison to the marginal cost in terms of unemployment inducing the union to set a higher real wage. The positive effect of I on the real wage premium in this case can be demonstrated formally by letting $B = 0$ in equation (7), differentiating it with respect to I and observing that, provided there is more than one union, the derivative is positive. Cukierman and Lippi (1999) refer to this mechanism as a "competition induced strategic non neutrality".¹⁰ In essence it arises because the level of CBC alters the marginal tradeoff between a higher real wage and competition over jobs at the level of the individual union.

2.4 Unemployment, inflation and CWB

Using equation (3) it can be shown that

$$u \equiv \frac{L - L^d}{L} = a\phi \tag{9}$$

implying that unemployment is higher the higher the wage premium. Since, due to the market power of unions, the equilibrium wage premium is positive, so is the "natural" rate of unemployment. Since there is no uncertainty and expectations are rational the rate of inflation is

¹⁰For a fuller discussion and a proof the reader is referred to proposition 5 of that paper.

forecasted perfectly by unions at contracting time. Imposing the rational expectations condition that $\pi = E\pi$ in equation (6) the equilibrium expression for inflation is:

$$\pi = \frac{a^2}{I}\phi \tag{10}$$

which replicates the well known KPBG result that inflation is positive when the natural rate of unemployment,(which is positive) is above the desired rate (zero in our case). The root source of the bias here is the market power of unions. The bias is lower the higher is CBC, I , and the lower the market power of unions as characterized by ϕ (since all wage premia are identical in equilibrium the bar on top of ϕ has been ommited).

Equations (9) and (10) imply that unemployment and inflation bear the same qualitative relation to CWB as does the wage premium. For example, if the parameters are such that the wage premium is an inverted U function of CWB, inflation and unemployment will also be inverted U functions of CWB.

3 CB - labor unions' interaction in the presence of monopolistically competitive price setting firms

When the CB is assumed to directly control inflation, monetary policy affects the economy only by changing the real content of contractually fixed nominal wages through inflation. Frameworks that use this modeling strategy implicitly assume that monetary policy affects the economy **only** through supply by changing real wages and the quantity of labor demanded. As a consequence, the large family of models that utilizes this assumption abstracts from traditional demand channels of monetary policy recently revived by advocates of the New - Keynesian approach to monetary theory and policy.¹¹ This section reviews recent extensions of the base line model that features **both** supply and demand driven transmission mechanisms of monetary policy. The extension introduces price setting monopolistically competitive firms and recognizes that

¹¹A survey of this approach appears in Clarida, Gali and Gertler (1999).

the monetary authority controls the money supply rather than inflation.¹² In this formulation product demand and therefore the demand for labor depend on real money balances. More precisely, given real money balances, each firm sets the price of its product so as to maximize its real profits. This determines the relative price of the firm, the demand for its product and the firm's derived demand for labor. As a consequence monetary policy affects employment and unemployment **also** by changing aggregate demand.

The strategic interaction between unions and the CB is represented, as in the base line model, by a sequence of events in which unions move first, set nominal wage contracts, and the CB moves second and chooses the money supply. But now there is a third stage in which each monopolistically competitive firm chooses its price, taking the previously determined nominal wages and the money supply as given. Thus, wages are sticky but prices are fully flexible. A central new element of this framework in comparison to the baseline model is that, when it sets the nominal wage, the individual union takes into consideration the effect of the CB response **also** on the demand for the goods produced by the firms that utilize its labor.

In particular, 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 the union's 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 the higher unemployment and the 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 conservative it reacts by contracting the money supply, thus aggravating the unemployment problem. If the CB is relatively liberal it reacts by expanding the money supply, thus aggravating the inflation problem. The union dislikes inflation as well as unemployment among its members. If it is relatively averse to unemployment, a higher level of CBC is associated with lower bargaining power for the union. If the union is relatively averse to inflation a lower level of CBC is associated with lower bargaining power for the union.

¹²This section draws on Coricelli, Cukierman and Dalmazzo (2000).

3.1 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 $i = 0, 1, \dots, n - 1$. Each firm owns a production technology that exhibits decreasing returns to scale to labor input, and is given by

$$Y_{ij} = L_{ij}^\alpha, \quad \alpha < 1 \tag{11}$$

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

$$Y_{ij}^d = \left(\frac{P_{ij}}{P} \right)^{-\eta} \frac{M}{P}, \quad \eta > 1 \tag{12}$$

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 (12) states that the demand facing the individual firm is increasing in real money balances and decreasing in the relative price of its product.¹³ The general price level is defined as the integral, over the unit

¹³The demand function in equation (12) 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. I will therefore sometimes refer to the total impact of real balances

interval, of the (logarithms of) the prices of individual firms. It is convenient to write it as

$$p = \frac{1}{n} \sum_{i=0}^{n-1} \left(\frac{\int_{\frac{i}{n}}^{\frac{i+1}{n}} p_{ij} dj}{\int_{\frac{i}{n}}^{\frac{i+1}{n}} dj} \right) = \sum_{i=0}^{n-1} \int_{\frac{i}{n}}^{\frac{i+1}{n}} p_{ij} dj = \int_0^1 p_{ij} dj. \quad (13)$$

where p_{ij} is the logarithm of P_{ij} and p is the logarithm of P . 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 .

The objective functions of unions and of the CB are the same as in the baseline model and are given respectively by equations (1) and (2).

3.2 Equilibrium

Equilibrium is characterized by backward induction. The firm's problem is solved first, then the CB problem and finally the union's wage decision.

3.2.1 Price setting by monopolistically competitive firms

Real profits of an individual firm are given by

$$\Pi_{ij} = \frac{P_{ij}}{P} Y_{ij}^d - \frac{W_i}{P} L_{ij} = \left(\frac{P_{ij}}{P} \right)^{1-\eta} \frac{M}{P} - \frac{W_i}{P} \left[\left(\frac{P_{ij}}{P} \right)^{-\eta} \frac{M}{P} \right]^{\frac{1}{\alpha}} \quad (14)$$

where the second equality is obtained by using (12), the demand facing the individual firm, and (11), 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:

on demand as a "generalized" real balance effect. Chapter 25 of Mishkin (2001) discusses the various channels through which monetary policy affects aggregate demand. A summary appears in figure 1 of that chapter.

$$p_{ij} - p = \theta + \frac{1}{\alpha + \eta(1 - \alpha)} [\alpha(w_i - p) + (1 - \alpha)(m - p)] \quad (15)$$

where θ is a combination of the basic model's parameters and lower case letters stand for the logarithms of the corresponding upper case letters. Equation (15) 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 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 (12)) with the firm's supply (equation (11)). Taking logarithms and rearranging yields:

$$l_{ij}^d = \frac{1}{\alpha} [-\eta(p_{ij} - p) + (m - p)]. \quad (16)$$

Equation (16) 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 (15) in equation (16), the firm's demand for labor can be rewritten in the alternative form

$$l_{ij}^d = \kappa + \frac{1}{\alpha + \eta(1 - \alpha)} [-\eta(w_i - p) + (m - p)] \quad (17)$$

where κ is a combination of the model's parameters. 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 labor demand plays a crucial role later.

3.2.2 Choice of money supply by the CB

The CB picks the money supply in the second stage so as to minimize its loss function (2), after observing nominal wages and anticipating the pricing and employment reaction of firms to its own choice (as given by equations (15) through (17)). Averaging equation (15) over firms and rearranging, yields

$$(m - p) = \rho - \frac{\alpha}{(1 - \alpha)}(w - p) \quad (18)$$

where ρ is a combination of the basic parameters of the model and p and w are respectively the logarithms of the average price and of the average nominal wage. Equation (18) states that, in the aggregate, there is an inverse **equilibrium** relation between the average real wage and real money balances. The equilibrium general rate of inflation can be obtained from equation (18) by rearranging and by subtracting the (log of) the previous period, historically given, price level, p_{-1} .

$$\pi = p - p_{-1} = -(1 - \alpha)\rho + \alpha w + (1 - \alpha)m - p_{-1}. \quad (19)$$

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. Averaging equation (16) over firms yields the (log of the) average level of employment per firm:

$$l^d = \frac{1}{\alpha}(m - p). \quad (20)$$

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 (20) reflects the "Keynesian" feature of the extended model, where monetary policy affects employment not only via supply but also through aggregate demand. Note that this Keynesian feature arises even though prices are completely flexible.

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, is therefore

$$u = l_0 - \frac{1}{\alpha}(m - p). \quad (21)$$

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 (19) and (21)) into the CB loss function in equation (2) and minimizing with respect to m yields the reaction function

$$m = \mu + \frac{1 - \alpha(1 - \alpha)I}{1 + (1 - \alpha)^2I} w. \quad (22)$$

where μ is a combination of the basic parameters of the model.

3.2.3 Wage setting by unions

Each union takes the nominal wages of other unions as given and chooses its own **nominal** wage so as to minimize the loss function in equation (1) while taking into consideration the effects of the reaction of the CB and of firms for the union's real wage, for unemployment among its members, and for to the general rate of inflation. Coricelli, Cukierman and Dalmazzo (2000) show that the (common) real wage premium that emerges from the solution to this problem is given by

$$\phi \equiv w_r - w_r^c = \frac{(1 - \alpha)^2 Z_w}{(1 - \alpha)AZ_u + \frac{B}{I}(1 - Z_w)} \quad (23)$$

where

$$1 - \frac{dp}{dw_i} \equiv Z_w = 1 - \frac{1}{n[1 + (1 - \alpha)^2I]} > 0 \quad (24)$$

and

$$-\frac{dl_{ij}^d}{dw_i} = \frac{du_i}{dw_i} \equiv Z_u = \frac{1}{\alpha} \left[\eta \frac{d(p_i - p)}{dw_i} - \frac{d(m - p)}{dw_i} \right] = \frac{1}{n} \left[\frac{\eta(n-1)}{\alpha + \eta(1-\alpha)} + \frac{(1-\alpha)I}{1 + (1-\alpha)^2 I} \right] > 0. \quad (25)$$

Notice that the wage premium is always non negative and that it increases with Z_w and decreases with Z_u , A and B . As in the baseline model Z_w is the overall elasticity of the union's **real** wage with respect to the nominal wage and is bounded between zero and 1. Similarly, Z_u is the (absolute value of) the overall elasticity of employment among union members with respect to the union's nominal wage. It is also equal to the marginal impact of an increase in the union's nominal wage on the rate of unemployment among union members.¹⁴ The overall elasticities, Z_w and Z_u , internalize the subsequent reactions of monetary policy and of prices to union i 's wage decision.

It is instructive to compare and contrast the expression for the wage premium here and in the baseline model. As in the baseline model the elasticity, Z_w , of the real wage with respect to the nominal wage is an increasing function of n and of I . An important difference between the models concerns the marginal impact, Z_u , of an increase in the union's nominal wage on unemployment among its members. Now this marginal impact depends on CBC, I . By contrast, in the baseline model it does not. The reason is that the baseline model does not incorporate an aggregate demand channel of monetary policy on economic activity into the analysis, while the present models does. It is easily seen, from equation (25), that higher values of CBC are associated with higher values of Z_u implying that, given Z_w , the wage premium is lower. Thus (given Z_w) the higher the level of CBC, the larger the union's cost, in terms of unemployment, of an increase in the nominal wage and the lower the bargaining power of the union. This non neutrality is related to the effects of the CB response to an increase in the union's nominal wage on the demand for goods, and through it, on the demand for the union's labor. The direction and magnitude of this response depends on CBC.¹⁵ The following subsection takes a deeper look

¹⁴To highlight the fact that, from a conceptual point of view Z_w and Z_u are the same in the two models, I am using the same notation for them across models in spite of the fact that their particular functional forms vary across models.

¹⁵Several additional results concerning the effects of CWB, n , and of product markets' local monopoly power,

at the consequences of this reponse.

3.3 Central bank conservativeness, accomodation, and unions' bargaining power

Examination of the reaction function of the CB in equation (22) reveals that, depending on the degree of CBC, I , the CB either counteracts or accommodates an increase in nominal wages. If the CB is sufficiently conservative ($1 - \alpha(1 - \alpha) I < 0$) a nominal wage increase triggers a tightening of the money supply. If the CB is relatively liberal ($1 - \alpha(1 - \alpha) I > 0$) it partially accommodates 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 in the pre EMU period as well as recent empirical evidence concerning monetary policy reaction functions supports the above mechanism. Studies of 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

η , on unions bargaining power are implicit in the expressions for the wage premium in equations (23)- (25). For further detail the reader is referred to Coricelli, Cukierman and Dalmazzo (2000).

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 effective CBC the coefficient of accommodation tends to be significantly positive; in countries with intermediate levels of CBC it is insignificantly different from zero; and in high CBC countries like Germany and Austria it is significantly negative. Those findings support a reaction function of the type that appears in equation (22). In countries with a highly independent and conservative CB, the monetary authority leans against inflationary wage increases by contracting money growth in response to wage inflation.

4 Should the central bank be more liberal or more conservative than society?

The answer to the question posed in the title of this section depends on the effects of CBC on unemployment and inflation. This largely depends, in turn, on whether a higher level of CBC raises or reduces the bargaining power of unions. The recent literature contains two opposing views on this issue. One is that, by raising the inflationary fears of unions, a more liberal CB (lower I) is more effective in deterring unions from raising wages. The other is that a less accomodating CB by raising unions' fears from unemployment, is more effective in achieving this objective. The first view is expressed in, or implied by, the work of Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999, 2002), Lawler (2000) and Lippi (2002). The second view is implied by the work of Soskice and Iversen (1998, 2000).

4.1 The populist central bank result

The first view above leads to the strong result that in the case of a single, inflation averse, monopoly union a populist or ultra liberal CB that does not care at all about inflation ($I = 0$)

is socially optimal. The framework is identical to that of Rogoff (1985) but without any shocks.¹⁶ Society dislikes both inflation and unemployment, and assigns a positive relative weight S to the cost of inflation. The higher S , the more averse is society to inflation in comparison to unemployment.

When all the labor force is represented by a single monopoly union the union fully internalizes the effect of its wage policy on the subsequent response of the money supply and of prices. Since the "ultra-liberal" CB cares **only about unemployment** it produces very high inflation even when unemployment is mildly positive. Even if it is only moderately averse to inflation (in the sense that B is small but strictly positive) the union strongly dislikes such high inflation. Knowing that even the slightest level of unemployment will induce the CB to inflate at an extremely high rate, the union reduces the wage premium to zero in order to avoid this calamity. And, indeed when the wage premium is zero, there is no unemployment and the CB has no reason to inflate. An ultra-liberal CB thus delivers both zero inflation and zero unemployment, maximizing social welfare.

As soon as there is more than one union this result no longer necessarily holds because the wage policy of each union is correctly perceived to have a smaller effect on CB policy than in the case of a monopoly union. As a consequence deterrence through the inflation fears of unions is smaller and extreme populism need not be socially optimal. In addition, when it is recognized that the degree of wage indexation is endogenous, the social optimality of appointing a populist CB no longer holds, even for the extreme case of a monopoly union. The reason, as pointed out by Liviatan (2001), is that the union will defend itself against the extreme inflationary tendencies of such a bank by indexing wages and this will neutralize the moderating impact of the union's inflation fears on its real wage demands.

¹⁶The absence of shocks implies that there is no motive for stabilization policy. Lawler (2000) provides a discussion of optimal contracts for central bankers in the presence of such a motive for the case of a monopoly union.

4.2 Deterrence through fears of unemployment versus deterrence through fears from inflation

Soskice and Iversen (1998, 2000) construct models in which the aggregate demand channel of monetary policy is incorporated explicitly. They show that a less accommodating CB, by raising the fears of unions from unemployment, reduces their bargaining power and, with it, the real wage. This begs the following question. What is the overall effect of CBC on the real wage, or the wage premium, when the deterring effects of unions' fears from **both** inflation and unemployment are acknowledged. Since the papers that stress unions' inflation aversion abstract from the effects of monetary policy via demand while the Soskice and Iversen (1998, 2000) papers abstracts from the inflation aversion of unions it is hard to judge from either group of papers which of those two deterring mechanisms is likely to dominate.

By incorporating unions' inflation aversion, aggregate demand and aggregate supply channels of monetary policy within **a single** framework the model in Coricelli, Cukierman and Dalmazzo (2000), reviewed in section 3, makes it possible to evaluate the factors that determine the overall effect of CBC on the real wage, unemployment and inflation. This framework implies that the equilibrium relations between unemployment and inflation, on one hand, and the wage premium on the other hand, are given by:

$$u = \frac{1}{1 - \alpha} \phi \tag{26}$$

$$\pi = p - p_{-1} = \frac{1}{(1 - \alpha)^2 I} \phi. \tag{27}$$

Hence, given I , unemployment and inflation are increasing functions of the wage premium.

The main lessons from the analysis in that paper are as follows. If the relative aversion of unions to inflation versus unemployment is large (B/A is large) deterrence works mainly through the inflation fears of unions. In such cases relatively liberal central banks are better at moderating the real wage demands of unions so that the wage premium is lower the more

liberal is the CB. This implies (from equation (26)) that unemployment is also lower under a relatively liberal CB. But, as can be seen from equation (27), the effect on inflation is generally ambiguous. Although a more liberal CB reduces the inflationary bias by lowering the wage premium and unemployment, it raises it directly since it cares less about the costs of inflation. Nonetheless, as pointed out by Guzzo and Velasco (2002) a CB that is more liberal than society may still be socially desirable in such a case.

When unions are relatively more averse to unemployment than to inflation (B/A is small) deterrence works mainly through the fears of unions from unemployment. Hence relatively more conservative central banks are more effective at reducing the bargaining power of unions and with it the wage premium, unemployment and inflation. In such a case, a CB that is more conservative than society is socially desirable since it unambiguously reduces both inflation and unemployment. Since, as implied by equation (22), the degree of accommodation is a decreasing function of CBC this case is consistent with the views expressed in Soskice and Iversen (1998, 2000).

Which one of those two deterring mechanisms is likely to dominate in reality? Coricelli, Cukierman and Dalmazzo (2000) show that for realistic values of B/A a CB that is more conservative than society is socially optimal. In addition their analysis suggests that the social optimality of a populist CB for which $I = 0$ is likely to be an extreme special case that arises only when B/A is relatively large and wage bargaining is highly centralized (n is very small).

5 Strategic and related effects of a monetary union

The recent formation of the European Monetary Union (EMU) changed the nature of the strategic interaction between the CB and labor unions within the Euro area. Prior to the formation of EMU labor unions within each country interacted only, or mainly, with the CB of their own country. With the creation of EMU, instead of facing its own national CB, each union now faces the European Central Bank (ECB). An important consequence of this institutional change is that the labor force of each union constitutes a smaller fraction of the total labor force in the Euro area than was the case hitherto, under decentralized national monetary policies. An immediate consequence of this observation is that, under EMU, each individual union internalizes

the consequences of its wage policy on the reaction of the ECB to a lesser extent than before.

A seemingly general intuitive implication of this observation is that unions' wage demands are moderated by the anticipated reaction of the CB to a lesser extent under a monetary union (MU) than under national monetary policies (NMP). This argument appears to apply both in the case in which this moderation is attained mainly because of unions' fears from unemployment, as well as in the case in which it is achieved mainly through their inflationary fears. Soskice and Iversen (1998) focus on the first mechanism and Gruner and Hefeker (1999) and Cukierman and Lippi (2001) focus on the second. Gruner and Hefeker (1999) consider the case of a single union per country. Cukierman and Lippi (2001) allow countries to differ in CWB, in size and in the degree of substitutability between labor of different unions across countries (the parameter γ in equation (3) varies across countries)

5.1 The strategic effect of replacing independent national monetary policies by a monetary union

With the formation of a MU each labor union becomes smaller relative to the monetary area in the sense that the impact of its wage policy on the area wide average wage and unemployment becomes smaller. When the dominant moderating mechanism is via unions' fears of unemployment, the increase in the number of unions facing a single CB moderates the perceived adverse employment repercussions of an increase in a union's nominal wage and leads to higher nominal and real wages. Similarly, when the dominant moderating mechanism is via unions' inflation fears, the increase in the number of unions moderates the perceived inflationary repercussions of an increase in a single union's nominal wage and leads to higher wage premia.

It turns out that this basic intuition holds under some, but not under all circumstances. In particular, Cukierman and Lippi (2001) show, using the baseline model of section 2, that if union and CB preferences are identical across countries, and do not change with the establishment of a MU, then the wage premium in the MU is higher than under NMP at all levels of the common value of CWB. They refer to this outcome as the "strategic effect" of a monetary union. We saw in section 2 that both unemployment and inflation are positively related to the

wage premium.¹⁷ Hence, under those circumstances, unemployment and inflation go up too when independent monetary policies are replaced by a MU.

This result needs to be qualified in several ways. First it assumes that the level of CBC remains unaltered before and after the creation of a MU. If (as was the case with the creation of EMU) average CBC goes up with the creation of a MU there may be, depending on the level of CBC and on the relative aversion of unions to inflation and to unemployment, an offsetting or a reinforcing effect. We saw in section 3 that, if the inflation aversion of the CB is high relatively to that of unions, an increase in CBC moderates real wages. Hence, under those circumstances, a higher level of CBC in the MU moderates the upward influence of the strategic effect on real wages unemployment and inflation. Second, the strategic effect of a MU unambiguously raises the wage premium only if the parameters γ and n of the baseline model (section 2) are not too dissimilar across countries and provided the countries do not differ too much in size.

5.2 The strategic effect of replacing a German dominated ERM by a monetary union.

For a substantial number of years prior to joining EMU some countries like Austria, the Netherlands and Belgium were essentially pegging their currencies to the German Mark via the Exchange Rate Mechanism (ERM). Such countries did not conduct independent monetary policies even before the advent of EMU. Instead they subjugated their monetary policies to the objective of maintaining a fixed peg to the German Mark. For such countries the change in institutions brought about by the creation of EMU altered the strategic interaction between unions and the monetary authority in a somewhat different way.

An analysis of the consequences of the replacement of a system of unilateral fixed pegs to the currency of a center country that conducts an independent monetary policy, by a MU appears in Gruner and Hefeker (1999) and Cukierman and Lippi (2001). The basic framework involves two groups of countries. A leader country that conducts monetary policy so as to minimize losses from domestic inflation and unemployment to which I will refer as Germany. The other is a group of follower countries that credibly subjugates its monetary policy to the

¹⁷See equations (9) and (10) of the baseline model.

objective of maintaining fixed pegs with respect to the German currency. The main result of both papers is that the replacement of a credible ERM by a MU should raise the wage premium in Germany and reduce it in the other follower countries. The conception underlying this result is illustrated by means of the baseline model of section 2 under the assumption that all parameters are identical across countries.

Under this characterization of the ERM, monetary policy in Germany in the pre-MU period is described by a NMP regime so that the equilibrium wage premium is still given by equation (7) of the baseline model. The crucial difference introduced by the existence of a credible ERM in the pre-MU period concerns the unions of the countries that precommitted to follow German monetary policy. Domestic inflation is unrelated to the wage premia of those unions, because they know that domestic inflation is determined by the German CB, which looks **only** at developments in Germany. Hence, each union in a follower country perceives that its individual action has no impact on the rate of inflation implying $Z_w = 1$. It follows that the wage premium in a follower country under the ERM is:¹⁸

$$\overline{\phi}_f^{ERM} = \frac{1}{\alpha A [\alpha + \gamma(n - 1)]} \quad (28)$$

which is larger than the premium obtained under NMP as given by equation (7).¹⁹ The fact that under a credible ERM the unions in the follower countries do not internalize the impact of their actions on inflation eliminates a deterrent to high wage claims and therefore leads them to adopt a more aggressive wage strategy.

Under this characterization, the creation of a MU should increase the wage premium of German unions and decrease the premia of unions in the follower countries. The reason is that the creation of a MU **reduces** the perceived impact of each individual German union on inflation whereas the opposite happens in the other countries, whose unions now correctly realize that their wage decisions have a non-zero impact on the inflationary reaction of the monetary union's CB. Again this conclusion requires appropriate qualifications when basic parameters differ markedly across countries.

¹⁸The subscript "f" designates a follower country's CB.

¹⁹This follows from the observation that the wage premium in equation (7) is increasing in Z_w .

5.3 Monetary union and labor market reform

The creation of a MU may alter policymakers' incentives to reform the labor market. This issue is relevant for Europe, where labor market rigidities are considered by many as an important determinant of poor employment performance (Bean, 1994; Nickell, 1997). Calmfors (2001a) has argued that the creation of EMU may stimulate reforms in labor market institutions.

Sibert and Sutherland (2000) have recently used a variant of the KPBG model to analyze this question. In their model monetary policy is discretionary and policymakers face an inflationary bias that is directly proportional to the rate of unemployment. Moreover, owing to international spillovers, inflation is higher when monetary policy is implemented in an uncoordinated manner (i.e. NMP) than in the MU. Policymakers have an incentive to reduce labor market distortions, because this lowers the equilibrium rates of unemployment and of inflation. A main point of their paper is that since, in their framework, inflation is lower in a MU than under NMP, the incentives to eliminate labor market distortions are lower in the MU than under NMP. But as we saw above, the creation of a MU may actually reduce the discipline of wage setters. Holden (2001) argues on this basis that the incentive to coordinate wage setting (in order to recapture some of the gains from the lost discipline) is therefore stronger in a MU. In view of those conflicting conclusions the more general message is probably that, depending on whether a MU raises or reduces real wages, the incentives for labor market reform are higher or lower under a MU.

5.4 Open economy extensions

Most of the models reviewed in this survey are closed economy frameworks that abstract from foreign trade linkages. Open economy extensions in a two countries world have recently been worked out by Coricelli, Cukierman and Dalmazzo (2001), Chprits (2002), Knell (2001) and Cavallari (2002). Those papers are open economy extensions of the type of framework surveyed in section 3 in which prices are set by monopolistically competitive firms and in which the CB chooses the money supply.

The first paper analyse the effects of institutions on economic performance in a monetary union in the presence of stabilization policy. It relates average, as well as country specific

economic performance within the monetary union to country size, number of unions, the degree of product differentiation on product markets, and CBC. Economic performance is characterized by unemployment, inflation, real wages and trade competitiveness. Both average, as well as, country specific, economic performance in the presence of (possibly) heterogeneous shocks and a unified stabilization policy are evaluated.

Using a similar framework Chprits (2002) reexamines the effects of replacing a "German" dominated ERM by a monetary union when monetary authorities choose the money supply rather than the rate of inflation and prices are set by monopolistically competitive firms. She finds that, other things the same, replacement of a "German" dominated ERM by a MU raises real wages in the follower country and reduces them in the leader country (Germany). The intuition underlying this result is that under the ERM the leader country sets its monetary policy without any regard for unemployment in the follower country and so does the follower country since it is bound by the rules of the credible ERM. This imposes substantial wage discipline on the unions of the follower country. By contrast, since they realize that their CB does care to some extent about domestic unemployment, unions in the leader country demand higher real wages. Under a MU the CB cares to some extent about unemployment in both countries but not as much about unemployment in the leader country as the leader's country CB did under ERM. As a consequence real wages under a MU are higher in the follower country, and lower in the leader country than under the ERM.

The paper by Knell (2001) examines the robustness of several results surveyed here to the incorporation of foreign trade linkages. The paper shows that the domestic Calmfors Driffill curve depends on the nature of both domestic and of foreign institutions. It also provides a further qualification to the result in Gruner and Hefeker (1999) and in Cukierman and Lippi (2001) (subsection 5.2) by showing that, when open economy linkages are acknowledged, the replacement of an ERM by a MU does not always increase unemployment. The paper by Cavallari (2002) examines the consequences of a MU in an open economy framework in which the typical labor union tries to maximize the average welfare of its members.

6 Concluding remarks

The notion that monetary policy has real effects due to some nominal rigidities has a long tradition in economics. The Keynesian notion that it is mainly the stickiness of **prices** that provides a lever for the real effects of monetary policy was seriously questioned during the seventies and the eighties, particularly by economists with a classical orientation. Believers in price stickiness sometimes appeal to the existence of price catalogues that are revised at discrete dates as evidence in favor of price stickiness. This casual evidence has been critiqued on the ground that, due to the existence of discounts and the possibility to adjust various qualitative dimensions of the product, prices are actually substantially more flexible than what would appear to be the case from price catalogues. In spite of those arguments macroeconomics has witnessed a remarkable revival of sticky prices models during the second half of the nineties. A survey of this approach appears in Clarida, Gali and Gertler (1999) and recent theoretical foundations are developed in Woodford (2002).²⁰

By contrast the literature surveyed in this article is built on the notion that nominal wages are sticky, or that they are, at least, substantially more sticky than prices. Casual observation, as well as more systematic work, like that of Stigler and Kindhal (1970) supports the view that this is a realistic presumption. This notion dictates the timing structure of the models used to depict the strategic interaction between wage setters, the monetary authority and price setters. Since they are bound by nominal contracts that are normally in effect for at least a year, wage setters are assumed to move first and to remain committed to the contract nominal wage over the period of the game. To reflect the fact that monetary policy is more flexible than nominal wages, the CB is assumed to move after wage setters. In the wide subclass of models that postulate, for simplicity (following KPBG), that the monetary authority directly controls prices this is a natural way to reflect the reasonable presumption that monetary policy and prices are both more flexible than wages.

In the subclass of models in which the CB chooses the money supply and prices are set by monopolistically competitive firms there are, apriori, two possible assumptions about the relative timing of moves between price setters and the choice of money supply by the CB.

²⁰See also Calvo (1982).

Assuming that price setters move first implies that prices are more sticky than monetary policy is, and assuming that the monetary authority moves first implies the opposite. Models with a New Keynesian orientation of the Clarida, Gali and Gertler (1999) type use the first assumption while the family of models with unions and price setting firms use (see section 3) the second assumption.

I believe that the second timing assumption is preferable for two reasons. First, as we saw above, the notion that wages are sticky is less controversial than the notion that prices are sticky. Second, given that there are sticky wages in the model, there is not much to be gained in terms of insights by introducing a second, and less probable, type of nominal stickiness. As a matter of fact it is likely that price stickiness in New Keynesian models is largely a reduced form proxy for the more substantial degree of wage stickiness observed in reality.

In the family of models reviewed in section 3 prices do not fully move when the money supply changes (see equation (19)). But this is not because it is costly to adjust prices. Instead, it is because it **does not pay** profit maximizing firms to fully adjust their prices in line with the money supply as long as **nominal wages have not been adjusted**. The upshot is that monetary policy has real effects, even in the presence of fully flexible prices, due to the existence of contractually fixed nominal wages.

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