

How Will EMU Affect Inflation and Unemployment in Europe?*

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Abstract

This paper explores how European Monetary Union will change the wage setting behavior of national labor unions. We derive the impact of national inflation aversion and labor militancy on the performance of national labor markets under different monetary arrangements. A common central bank raises inflation and unemployment if it acts as conservatively as national central banks. However, unemployment falls in countries that previously tied their monetary policy to the Bundesbank. We also examine the composition of EMU and the influence of national labor market legislation.

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JEL classification: E24; F02; F33

I. Introduction

One of the most important issues in current economic policy is the impact European Monetary Union (EMU) will have on European labor markets. Given a situation of high, persistent and even growing rates of unemployment, the (political) success of every economic policy is unseparably tied to its impact on the labor market. This is particularly true for monetary union. Our aims in this paper are first, to explore whether EMU will have an effect on national labor markets and lead to more or less employment in member countries, and second, to study the way in which different attitudes towards economic stability influence inflation and unemployment in the participating countries.

So far, two approaches to unemployment and (monetary) integration may be discerned in the literature. The first is the well-known optimum currency area approach which formulates requirements of national labor markets to

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make monetary union viable without leading to a loss of employment. The second analyzes real integration in the tradition of Calmfors and Driffill (1988), focusing on the level of wage bargaining and integration. While this literature addresses the interaction of national labor unions via non-competitive product markets, our approach highlights the strategic interaction of labor unions that arises through the creation of a common central bank in perfectly competitive product markets.¹

We show that EMU will have an effect on unemployment when national labor unions are concerned with monetary stability *per se*. Following recent work by al-Nowaihi and Levine (1994) we assume that labor unions are, to a certain extent, inflation averse. Inflation not only reduces the real wage of the representative member, but also has a negative effect on savings accounts, pensions and other nominally fixed assets of union members.² This plausible assumption turns out to be crucial for the performance of labor markets under EMU. Absent inflation aversion, the monetary regime does not matter. This is because unions as Stackelberg leaders are always able to select their most preferred point on the labor demand curve. Adding preferences for monetary stability changes this neutrality. Knowing that the common central bank will react to excessive wage claims, national labor unions are able to realize real wage increases because the rise in inflation is less than the nominal wage increase. Higher EMU-wide nominal wage claims are the consequence. Given that the European Central Bank will only partially accommodate the wage increase, there is a higher real wage resulting in higher unemployment.

Our analysis also allows for differences in union characteristics across member countries and shows how inflation and unemployment are affected by changes in characteristics of member countries. This is important for two reasons. It helps to explain the influence of the composition of EMU on national performance, and derives the influence of national labor market legislation.

The paper is organized as follows. In Section II we relate our paper to the existing literature. Section III introduces the setup of the model. Preferences of the agents involved are described and the equilibrium under monetary autonomy for each country is derived. In Section IV we briefly discuss the case of countries which have already given up their monetary autonomy in

¹To assess EMU effects on employment, we focus on the wage setting behavior of labor unions, although this is certainly not the only relevant influence. Other possible effects include changes in trade structure, direct investments, etc. which may also have an influence on national rates of unemployment.

²Although most of the literature neglects inflation concerns of labor unions, the assumption is supported by union statements. For instance, the peak organization of German labor unions has expressed its demand that inflation continue to be low under EMU; see DGB (1995).

the European Monetary System (EMS) by pegging to the deutsche mark. Section V moves the game to the EMU stage and derives our main results. We discuss the case of similar union preferences in every member country and then allow for different preferences with regard to employment and inflation *vis-à-vis* the real wage aim. This allows us to discuss both the composition of EMU and the effects of labor market policies.

II. Economic Integration and Unemployment: The Literature

Our analysis of the impact of monetary union on employment is related to two strands of literature. The first is the extensive literature on optimum currency area theory which analyzes labor market flexibility and monetary policy. The second is concerned with extensions of the Calmfors and Driffill (1988) analysis of the organization of wage bargaining and unemployment to product market integration in Europe.

The optimum currency area theory would imply that EMU affects labor markets because it deprives its participants of an important adjustment instrument, the exchange rate. Given nominal wage rigidity, it has been argued by Mundell (1961) that adverse demand shocks for the goods of a country can be cushioned either by exchange rate devaluation or, if that channel is blocked through fixed exchange rates, by labor mobility. Labor should move from the country where demand is depressed to the country where demand is expanded, thereby bringing wages back into line with prices and restoring the employment level. This theory thus tells us that high labor mobility substitutes for exchange rate changes. However, it is not founded on a microeconomic analysis of the sources of nominal rigidities. As we will see, providing such a microeconomic foundation has an important influence on the results.

Given rational expectations, unions know that excessive real wage demands can be mitigated by devaluations if negative shocks occur and require a downward adjustment of wages. The loss of monetary autonomy might then exert disciplinary pressure on national labor unions, as they realize that monetary autonomy is no longer given and that hence wages translate directly into unemployment rather than into inflation as in a purely national framework; see Horn and Persson (1988).³ Eichengreen (1996) hence argues that EMU should discipline wage setting behavior.

The second literature to which our paper is related is the analysis of wage externalities created by national labor unions in the case of product market integration. This literature is based on the Calmfors and Driffill (1988)

³For empirical evidence on the interaction between exchange rate regimes and labor union behavior, see Alogoskoufis and Smith (1991).

model where the organization of national labor markets is the pivotal factor for their performance. When wage setting concerns a whole industry, so that wages rise simultaneously across all firms producing similar products, firms can pass wage rises on to consumers via an increase in the relative output price. In this situation, unions have little incentive for wage restraint, because part of the negative employment effect can be externalized. Thus, intermediate level bargaining gives rise to a prisoners' dilemma situation where each single union exploits the trade-off between market power and employment. This is different in completely decentralized wage bargaining where every single firm is price-taker. The single firm has no opportunity to increase its relative price when real consumption wages increase, so that there is no relative price increase to offset a wage increase. Exactly the same is true for complete centralization because a uniform wage and price increase across all industries leaves relative amounts unchanged. Unions' incentives to raise wages are reduced with equally positive employment effects.

An analysis based on this idea would suggest that goods market integration will increase or decrease employment depending on the degree of centralization before integration. If there was country-wide bargaining before integration, then integration would reduce employment. However, if it is sectoral, then integration may lead to more decentralization and more employment. Optimistic observers even expect that, as the degree of market integration increases, competition increases as well. Danthine and Hunt (1994) have argued that national labor unions most likely will quickly realize that competition has increased and that external pressure will thus discipline unions at all levels of centralization. Hence the postulated hump-shape between labor market organization and real wages will become flatter and the particular organization of the respective national labor market will lose its determining influence.

However, focusing on imperfect substitutability between home and foreign goods, Corneo (1995) has established a positive wage externality among national labor unions in integrated product markets because wage increases in one country increase competitiveness of the other country. This will induce labor unions there to demand higher wages too, thus increasing overall unemployment as unions bid each other up. Driffill and van der Ploeg (1993) and Rama (1994) have also noted that wages might indeed increase under trade liberalization, because they improve a country's terms-of-trade. Unemployment is thus traded off against real consumption wage increases. Corneo (1995) and Driffill and van der Ploeg (1993) conclude that there is an incentive for national labor unions to coordinate themselves at a supranational level to mitigate these negative wage externalities. These analyses, however, are restricted to the case of product market integration. In contrast, we show that similar negative spillover effects can arise even in the presence

of perfect competition because of the interaction of national labor unions via a common central bank.

III. The Model

Production

We consider for simplicity only two countries ($i = 1, 2$) that will form a monetary union. Since our focus is the interaction of labor unions with central banks, we assume, also for simplicity, that product markets are perfectly integrated and that both countries produce the same homogeneous good. This allows us to abstract from sectorally differentiated products and imperfect competition. Purchasing power parity holds, hence monetary policy has no effect on international competitiveness. Nominal exchange rate changes reflect price differences between countries, so that the real exchange rate is constant.

The productive sector in each country is represented by a Cobb-Douglas technology

$$Y_i = K_i^{1-\gamma} N_i^\gamma, \quad \gamma \in [0, 1] \quad (1)$$

where the capital stock K is constant and normalized to 1. Labor N is employed by profit-maximizing firms to the point where its marginal productivity is equal to the real wage

$$N_i = \frac{1}{\gamma} \left(\frac{W_i}{P_i} \right)^{1/(\gamma-1)}, \quad (2)$$

where W_i and P_i denote the national wage and price levels, respectively. We normalize $P_{i,-1} = 1$. Throughout the paper lowercase letters denote natural logarithms and parameters are constant and positive. π denotes inflation and therefore the logarithm of the current price level. Taking natural logarithms of (2) gives the labor demand schedule

$$n_i = -\ln \gamma - \frac{1}{\gamma-1} (w_i - \pi_i) \equiv a_0 - a_i (w_i - \pi_i). \quad (3)$$

We assume that labor is supplied inelastically. Hence the level of employment is determined by the labor demand schedule (3).

The Labor Union

In what follows we assume that preferences of all national labor union members are identical and, since firms produce a homogeneous good, this allows us to represent them by a single union that covers the whole country

and maximizes the objectives of a representative union member. His or her objectives are given over real wages ($w - p$) and unemployment $\bar{n} - n$. Employment is below full employment because unions are willing to trade off real wages for employment.⁴ The union is also opposed to inflation because this not only reduces the real wage of the representative member, but also has a negative effect on the member's savings accounts, pensions and other nominal assets, thus imposing welfare costs on the union member as well; see al-Nowaihi and Levine (1994).

Our assumptions are reflected in the following utility function for the labor union in country i :

$$U_i = (w_i - \pi_i) - \frac{c_i}{2} \pi_i^2 - \frac{\alpha_i}{2} (n_i - \bar{n}_i)^2. \quad (4)$$

Without loss of generality we set $a_0 \equiv \bar{n}_i$. $1/\alpha_i$ is our measure of union aggressivity that is determined by the influence of the group of insiders in the labor union. It also reflects national labor legislation because this determines labor turnover costs and rigidities, and thus the insiders' power in wage setting; see Lindbeck and Snower (1988).

The Central Bank

Following the literature initiated by Barro and Gordon (1983) we assume that the central bank seeks full employment and ideally zero inflation, having perfect control over the rate of inflation. Thus, we do not consider fiscal aspects of monetary unification which are thought to have a short-run effect on unemployment as well. Likewise we do not discuss seigniorage or real debt motives for monetary expansion. The utility function of the central bank is hence described as

$$U_{CB_i} = -\frac{1}{2} \pi_i^2 - \frac{b_i}{2} (n_i - \bar{n}_i)^2. \quad (5)$$

⁴The existence of labor turnover costs gives employed workers market power which they use to set their wage demands without taking the unemployed into account. Because labor unions are dominated by these insiders, they set wages that are compatible with the current level of employment. As e.g. Blanchard and Summers (1989) have shown, this is an important characteristic of European labor markets. Although Layard *et al.* (1991) argue that a single labor union is likely to take the unemployed into consideration when setting wages, we follow Lindbeck and Snower (1988) who argue that the unemployed become outsiders immediately after losing their jobs. Since insiders alone set wage demands, it is likely that they disregard the interests of outsiders; see also Calmfors (1993).

The National Case

We first analyze the case where each country has full monetary autonomy. This is adequate for those countries which operated under wide bands in the European Monetary System (EMS), were not members of it, or have a *de facto* free float since 1992. We model national wage setting and monetary policymaking as a one-shot game without reputational effects, because reputational effects lose importance when unemployment hysteresis eradicates incentives to build up reputation; see Grüner (1996). Events unfold as follows. In the first stage labor unions in each country simultaneously set their wages. Then central banks set the rate of inflation and thus determine the real wage in the economy. Nominal contracts are binding for the whole period and indexation is ruled out, so the central bank determines the real wage of labor. Finally production takes place; enterprises hire labor on the basis of the realized real wage and the employment level is determined. The solution concept is subgame perfect Nash equilibrium.

Since purchasing power parity holds, there is no strategic link between players in different countries, which drives the results in papers with imperfect product markets; cf. Corneo (1995), Driffill and van der Ploeg (1993), and Rama (1994). Therefore, we consider each country separately. As the Stackelberg leader in this game, the union is aware of the reaction function of the national central bank which follows from the maximization of (5) and is given as

$$\pi_i = \frac{a_i^2 b_i}{1 + a_i^2 b_i} w_i \equiv \Psi_i w_i. \quad (6)$$

The union maximizes its utility (4), taking the central bank reaction (6) into account. The resulting wage claim is:

$$w_i = \frac{(1 - \Psi_i)}{\alpha_i a_i^2 (1 - \Psi_i)^2 + c_i \Psi_i^2}. \quad (7)$$

By subtracting (6) from (7) we arrive at the following real wage:

$$\tilde{w}_i = \frac{(1 - \Psi_i)^2}{\alpha_i a_i^2 (1 - \Psi_i)^2 + c_i \Psi_i^2}, \quad (8)$$

which, given labor demand (3), leads to the following employment level:

$$n_i = \bar{n}_i - \frac{a_i (1 - \Psi_i)^2}{\alpha_i a_i^2 (1 - \Psi_i)^2 + c_i \Psi_i^2}. \quad (9)$$

IV. An Asymmetric EMS

We now turn to the relation between Germany and the inner group of the EMS. The asymmetric working of the EMS reduced the abilities of other central banks to react to domestic conditions by setting independent monetary policy. Instead of setting monetary policy independently, they had to follow Germany in order to stabilize the bilateral exchange rate. We model this situation by assuming that the Bundesbank unilaterally sets the rate of inflation for the whole core EMS, although without accounting for developments in other economies.

In this case inflation, wage claims and employment in Germany are still described by equations (6)–(9). For other countries, like France, the Netherlands and Austria, the situation is different. At the stage where labor unions in those countries set their nominal wage demands, they correctly anticipate the rate of inflation set by the German Bundesbank. This rate is fully independent of national wage claims in those economies.

The unions in the EMS core countries maximize the following utility function:

$$U_i = (w_i - \bar{\pi}_i) - \frac{c_i}{2}\bar{\pi}^2 - \frac{\alpha_i}{2}(n_i - \bar{n}_i)^2, \quad (4')$$

where $\bar{\pi}$ is the rate of inflation set by the Bundesbank.

The nominal wage set by the union is given as $w_i = \bar{\pi} - 1/\alpha_i a_i^2$, leading to an employment level of $n_i = \bar{n}_i - 1/\alpha_i a_i$. This corresponds to the case where unions do not care about inflation ($c_i = 0$). Each union simply chooses its bliss point on the labor demand curve, since it has no opportunity to influence the rate of inflation.

V. European Monetary Union

With the movement to a common currency, the national central banks are succeeded by the European Central Bank (ECB). Hence national central banks no longer have the autonomy to react to national wage claims when setting their monetary policy but are merely executing agencies for the ECB. The ECB, however, now takes unemployment in each member country into account when setting its monetary policy.

The utility function of the ECB is then given as

$$U_{\text{ECB}} = -\frac{1}{2}\pi^2 - \sum_i \frac{b}{2}(n_i - \bar{n}_i)^2, \quad i = 1, 2. \quad (5')$$

Although it might be argued that the ECB would (or should) only be

concerned with overall unemployment in Europe, our assumption is that it aims at full employment in every single country.⁵ Maximization of (5') then yields a European inflation rate which is a function of wage claims in the two countries. The inflation rate set by the central bank is given as

$$\pi^{\text{EMU}} = \frac{b(a_1^2 w_1 + a_2^2 w_2)}{1 + b(a_1^2 + a_2^2)} \equiv \Phi_1 w_1 + \Phi_2 w_2. \quad (10)$$

In order to isolate the impact of trade union interaction on inflation and employment from any possible effect of changes in central bank preferences, and because the future degree of inflation aversion of the ECB cannot be predicted, we assume that the ECB is as inflation averse as its predecessors. Formally, this assumption means $\Phi_i \equiv \Psi/2$ and implies that the common central bank responds the same way to a one euro rise in wages in each country as a national central bank would respond to a one euro rise in its own country.

The Case of Symmetric Unions

It is instructive to first analyze the case where the preferences of national labor unions are identical, i.e., $\alpha_1 = \alpha_2 \equiv \alpha$ and $c_1 = c_2 \equiv c$. National labor unions play a Nash game against each other in this context, but continue to be Stackelberg leaders *vis-à-vis* the ECB.

Each national union will chose the nominal wage by maximizing (4), taking (10) into account. The equilibrium wages in both countries are

$$w_i = \frac{(1 - \Phi)}{\alpha a^2 (1 - 2\Phi)(1 - \Phi) + 2c\Phi^2}. \quad (11)$$

This will result in the following real wage:

$$\tilde{w}_i = \frac{(1 - 2\Phi)(1 - \Phi)}{\alpha a^2 (1 - 2\Phi)(1 - \Phi) + 2c\Phi^2}, \quad (12)$$

which leads to an employment level of

$$n_i = \bar{n}_i - \frac{a(1 - 2\Phi)(1 - \Phi)}{\alpha a^2 (1 - 2\Phi)(1 - \Phi) + 2c\Phi^2}. \quad (13)$$

⁵A central bank utility function where overall EU unemployment enters would not alter our results. It leads to a reaction function which is linear in national wages like equation (10).

We can now compare a monetary union with the two pre-EMU alternatives. Proposition 1 considers the case with monetary autonomy in the EMS:

Proposition 1. *Assume that national labor unions have identical preferences and that the ECB is as conservative as the national central banks. Then*

- (i) *monetary union increases national nominal wages,*
- (ii) *the inflation rate under EMU is higher than the national inflation rate,*
- (iii) *monetary union raises unemployment,*
- (iv) *EMU decreases unions' utility in both countries.*

Proof: See Appendix.

The results of Proposition 1 are due to the prisoners' dilemma situation in which the national labor unions find themselves in a monetary union. National unions no longer fully internalize the effects of wage claims on inflation. Therefore, wage demands and inflation are higher in equilibrium. The negative effect on employment follows because the ECB is not willing to accommodate the competitive wage demands of the labor unions fully. The rate of inflation increases due to the central bank's reaction to higher nominal wage claims, but it does not increase enough to avoid an increase in unemployment. The decline in the unions' utility is due to the fact that they experience a loss in their control of the rate of inflation and have higher unemployment.

These results, as can easily be seen, are crucially dependent on our assumption that $c > 0$. When unions do not care about inflation, EMU changes nothing for the national labor markets. In this case employment is unchanged because national wage demands and hence real wages are unchanged.

We next turn to those countries which had already tied their monetary policy to the German policy in the EMS. Employment unambiguously increases in these countries since the ECB, in contrast to the Bundesbank, takes the wage claims of unions in these countries into account. Therefore, as in Proposition 1, inflation increases in EMU. However, union utility in both countries decreases. This is established in Proposition 2.

Proposition 2. *Consider two countries where country 1 (the follower) ties its monetary policy to that of country 2 (the leader), and where the preferences of the national labor unions are identical. If both join a monetary union where the central bank is as conservative as that of country 2, then*

- (i) inflation in the monetary union rises,
- (ii) employment increases in the follower country and falls in the leader country,
- (iii) monetary union decreases union utility in both countries.

Proof: See Appendix.

Both Propositions 1 and 2 indicate that trade unions are among the losers from monetary union.⁶ This might explain why they are more hesitant than the business community regarding the move towards EMU. Accordingly, the move to monetary union could receive more political support if it were accompanied by side-payments from winners to losers.⁷ Given that real wages are lower in the EMS follower countries, the group of winners in those countries would consist of firms and the currently unemployed.

The Case of Asymmetric Unions

We now turn to the case where national labor unions' preferences differ. This is important for two reasons. First, allowing that national labor unions' preferences differ is necessary for understanding how the composition of EMU affects national employment. Second, this exercise will provide insight into how national legislation aimed at changing labor union behavior will create spillover effects in a monetary union. Thus in this section $\alpha_1 \neq \alpha_2$ and $c_1 \neq c_2$. We keep our assumption that $\Phi_1 = \Phi_2 = \Psi/2$.

In this scenario, the central bank will not change its behavior, i.e., the rate of money growth set by the ECB is still as in equation (10). The nominal wages set by the unions in the two countries are now given as

$$w_i = \frac{a^2(1 - \Phi)[\alpha_j(1 - \Phi) + \alpha_i\Phi] + \Phi^2(c_j - c_i)}{a^2[\alpha_i\alpha_j a^2(1 - 2\Phi)(1 - \Phi) + \Phi^2(\alpha_i c_j + \alpha_j c_i)]}, \quad i, j = 1, 2; \quad i \neq j. \quad (14)$$

Nominal wage claims show that the more inflation averse the union in the other country, the higher the wage claim in the home country. Discipline in one country thus poses an incentive for the union in the other country to increase its wage demands. This is possible because less inflationary pressure from the other union relaxes the constraint from own inflation aversion.

⁶We disregard the relations of EMU to the rest of the world. If European goods were assumed to be imperfect substitutes for those from outside countries, these effects could improve the European terms-of-trade and partially offset the utility loss for unions. Extending our assumption of homogeneous goods to outside countries allows this effect to vanish.

⁷This was pointed out to us by a referee.

The nominal wages lead to the following real wages in the two countries:

$$\tilde{w}_i = \frac{a^2(1 - \Phi)[\alpha_j(1 - 2\Phi)] + \Phi^2(c_j - c_i)}{a^2[\alpha_j\alpha_i a^2(1 - 2\Phi)(1 - \Phi) + \Phi^2(\alpha_i c_j + \alpha_j c_i)]}, \quad i, j = 1, 2; i \neq j. \quad (15)$$

These finally result in national employment levels of

$$n_i = \bar{n}_i - \frac{a^2\alpha_j(1 - 2\Phi)(1 - \Phi) - \Phi^2(c_j - c_i)}{a[\alpha_i\alpha_j a^2(1 - 2\Phi)(1 - \Phi) + \Phi^2(\alpha_i c_j + \alpha_j c_i)]}, \quad i, j = 1, 2; i \neq j. \quad (16)$$

Equations (14)–(16) give rise to the following spillover effects which differ from those we derived under the assumption of identical preferences:

Proposition 3. *Inflation aversion in country j increases unemployment in country i .*

Proof: To see this, differentiate (16) to obtain $\partial n_i / \partial c_j < 0$. *Q.E.D.*

The intuition for this result is that inflation aversion in country 2 exerts a downward pressure on Europe's inflation rate. This reduces the marginal costs of inflation for the labor union in country 1 and thus induces it to demand higher real wages. The rate of unemployment in country 1 increases. The same intuition leads us to the following Proposition:

Proposition 4. *Union concern for employment in country j increases unemployment in country i , if country j is not too inflation averse.*

Proof: This is evident from rewriting (16) as

$$n_i = \bar{n}_i - \frac{(\alpha_j A + B)}{\alpha_j C + D}.$$

where $A = a^2(1 - 2\Phi)(1 - \Phi)$, $B = \Phi^2(c_j - c_i)$, $C = \alpha_i a^3(1 - 2\Phi)(1 - \Phi) + a\Phi^2 c_i$ and $D = a\Phi^2 c_j \alpha_i$.

Differentiating n_i with respect to α_j , we have

$$\frac{\partial n_i}{\partial \alpha_j} = \frac{BC - AD}{(\alpha_j C + D)^2}.$$

The condition for this expression to be negative is $AD > BC$. This is the case if

$$c_j - c_i < a^2 \alpha_i \frac{(1 - \Phi)(1 - 2\Phi)}{\Phi^2}. \quad Q.E.D.$$

VI. Conclusion

So far, research on the impact of European integration on labor markets has mainly focused on the interaction of trade unions when product markets are imperfectly competitive. Our analysis shows that monetary integration establishes a second link between national labor markets even when product markets are perfectly competitive. We have shown that EMU will have a significant impact on both real wages and employment in the countries involved. Among the employment winners from monetary union are those countries that previously tied their monetary policy to the Bundesbank's because, in contrast to the Bundesbank, a European Central Bank will take unemployment in those countries into account when setting monetary policy. For the other countries, however, unemployment will increase because the ECB will accommodate excessive wage claims less than national central banks previously did.

It should be noted, however, that these results only hold if unions continue to act non-cooperatively in the changed environment created by EMU. Non-cooperative wage setting results in a prisoners' dilemma situation where national unions do not fully internalize the inflationary pressure they create. Our analysis therefore also suggests that EMU will provide stronger incentives for unions to cooperate internationally. Cooperation, however, does not mean that wage demands should be equalized across countries. When union preferences differ, wages will be lowered when unions cooperate, but not necessarily to the same level. Should unions not be able to coordinate their wage setting in the sense mentioned, the alternative would consist of national legislation aiming to reduce insiders' power in the wage setting process. Our analysis suggests, however, that such government measures must be internationally coordinated as well in order to avoid adverse spillover effects from national legislation.

Appendix

Proof of Proposition 1

(i) Given our assumption that $\Phi_i = \Psi/2$, the nominal wage set by both labor unions in EMU can be written as $w_{\text{sym}}^{\text{EMU}} = 1/((1 - \Psi)\alpha a^2 + c\Psi^2/(2 - \Psi))$. The national wages set before EMU can be rewritten as $w^{\text{NAT}} = 1/((1 - \Psi)\alpha a^2 + c\Psi^2/(1 - \Psi))$. Hence $w_{\text{sym}}^{\text{EMU}} > w^{\text{NAT}}$.

(ii) Since the nominal wages set by the labor union are higher under EMU, this implies from (10) that $\pi_{\text{sym}}^{\text{EMU}} > \pi^{\text{NAT}}$.

(iii) Real wages under symmetric EMU are given as $\tilde{w}_{\text{sym}}^{\text{EMU}} = (1 - \Psi) / ((1 - \Psi)\alpha a^2 + c\Psi^2(2 - \Psi))$, whereas real wages in the national case can be written as $\tilde{w}^{\text{NAT}} = (1 - \Psi) / ((1 - \Psi)\alpha a^2 + c\Psi^2 / (1 - \Psi))$. Thus $\tilde{w}_{\text{sym}}^{\text{EMU}} > \tilde{w}^{\text{NAT}}$ which implies $n_{\text{sym}}^{\text{EMU}} < n^{\text{NAT}}$.

(iv) In both regimes, the inflation rate and the nominal wage are linked by the equilibrium relationship $\pi = \Psi w$. In the national case, each trade union maximizes its utility function taking this relationship as a reaction function of the central bank into account. It therefore maximizes:

$$U_i = (1 - \Psi)w - \frac{c}{2}(\Psi w)^2 - \frac{\alpha a^2}{2}[(1 - \Psi)w]^2. \quad (\text{A1})$$

This is a concave function of the nominal wage with a unique maximum at $w = w^{\text{NAT}}$.

In the currency union, national unions no longer exploit the relationship (A1) separately, but jointly determine the reaction of the central bank. This is why the nominal wage in the currency union $w_{\text{sym}}^{\text{EMU}} > w^{\text{NAT}}$. Hence, $w_{\text{sym}}^{\text{EMU}}$ does not maximize (A1) and union utility falls with monetary union. *Q.E.D.*

Proof of Proposition 2

(i) EMU nominal wages are again given by $w_{\text{sym}}^{\text{EMU}} = 1 / ((1 - \Psi)\alpha a^2 + c\Psi^2 / (2 - \Psi))$ which is higher than the German wage level before EMU. Hence, via (6) and (10), inflation increases.

(ii) The resulting real wage $\tilde{w}_{\text{sym}}^{\text{EMU}} = (1 - \Psi) / ((1 - \Psi)\alpha a^2 + c\Psi^2 / (2 - \Psi))$ is above country 2's previous real wage level, as we know from Proposition 1. The real wage before monetary union in country 1 was $\tilde{w}_1 = 1 / \alpha_1 a_1^2$, which is higher than $\tilde{w}_{\text{sym}}^{\text{EMU}} = 1 / (\alpha a^2 + c\Psi^2 / (1 - \Psi)(2 - \Psi))$. This has the employment effects stated.

(iii) First note that the utility of the German trade union is independent of whether the foreign central bank follows the Bundesbank or whether it conducts an autonomous monetary policy. In both cases, inflation, the wage and employment are given by (6), (7) and (9). Therefore, from Proposition 1(iv) we know that utility of the German union falls with EMU.

Next we show that union utility in the follower country in the asymmetric EMS is larger than in the leader country. Both countries have the same inflation rate. The follower country's trade union can choose its bliss point on the labor demand curve without taking inflation into account. Union utility in the follower country is given by $U_{\text{asym}}^{\text{EMS}} = w - \bar{\pi} - c/2\bar{\pi}^2 - \alpha a^2/2(w - \bar{\pi})^2$.

Given the inflation rate $\bar{\pi}$, union utility is strictly concave in the nominal wage and has a unique maximum. The trade union in the follower country is free to choose this optimal wage. Now let the German trade union demand a lower nominal wage than the union in the follower country because it knows that the central bank reacts to its wage claim. Given that both countries have the same inflation rate, union utility in the follower country must then be larger than in Germany. Finally, note that under EMU, both unions have the same utility level. Hence we have that utility of the follower country's union also falls with EMU. *Q.E.D.*

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