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Labor Market Reform and Wage Bargaining in a Monetary Union*

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Abstract

This paper examines the effect of monopolistic labor unions' behavior on governments' incentives to undertake labor market reform, inside and outside a monetary union (MU). Our principal findings are as follows: incentives for reform are increased inside the MU when Governments and Labor Unions move simultaneously in the first stage of the policy game, taking as given the reaction of each other. Inside the MU there is also a possibility of a "race to the bottom" with respect to labor market reform; this can be avoided by the cooperation of fiscal authorities in deciding labor market reform.

1 Introduction

The performance of labor markets in Europe after the Economic and Monetary Union (EMU) is crucial for the long-run success or failure of the monetary union: with the introduction of the euro, exchange rate and monetary policies are no longer available at the national level as tools for macroeconomic adjustment. Furthermore, fiscal policy is restrained by the Pact on Stability and Growth and the tendency to fiscal harmonization. Without the nominal exchange rate as shock absorber mechanism, asymmetric and possibly symmetric shocks might exert increased pressure

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on national labor markets and entail a substantial risk of rising unemployment. So the national governments should undertake reforms that enhance labor market flexibility, providing thus an alternative adjustment mechanism to these shocks.

Andersen et al (2000), as well as Bertola and Boeri (2001) have put forward a “real effects” of EMU argument that leads to more reform in the post-EMU era. According to this economic stability, higher product market competition, and increased economic integration will be characterizing the post-EMU era. Thus, in this context relative labor costs will become a crucial factor in firms’ locational decisions. Hence, governments will try to make the environment more attractive for firms, in order to encourage capital investments; which will lead to more labor market reform that lowers labor costs¹.

An alternative perspective on labor market reform is provided by the “time inconsistency” approach. In this context, the monetary authority wants to get inflation and unemployment close to their targeted levels. Monetary policy decisions are taken after inflation expectations have been formed so there exists a short-run trade off between inflation and unemployment that governments try to exploit. Moreover, product and labor market imperfections lead to divergence of the natural level of unemployment from the targeted level. Under the rational expectation hypothesis employed in this model, the private sector correctly anticipates the government’s reaction. This will lead to even higher inflation without reducing unemployment.

Notice that in this framework, the higher the gap between the natural rate of unemployment and the targeted unemployment rate, the higher the equilibrium inflation. So inflation bias (arising from discretionary monetary policy) can be reduced by appointing a conservative central banker (Rogoff 1985), by establishing a linear contract between the government and the central banker (Walsh 1995), by introducing an inflation target (Svensson 1997), or by reducing distortions in the labor market (Calmfors 2001). Incentives for (costly) reform will be greater when the time inconsistency problem has not been addressed. However, these incentives are fewer inside the EMU since the act of delegation of the monetary policy to the “very conservative” European Central Bank (ECB) eliminates the inflationary bias, reducing the need for reforms². In the

¹According to this view labor market deregulation might result in a “race to the bottom”.

²Hallett and Viegli (2001) support this view in a slightly different setting. They distinguish the labor market institutions according to the degree of centralization of the wage bargaining (WB), and have the fiscal authority influencing the labour costs. Centralized WB (less flexibility/reform) provides an extra instrument of economic policy because wage restraint by the union increases the competitiveness of the national economy relative to member states. On the contrary, under Decentralized WB (more flexible/reformed) national objectives can be only pursued by fiscal policies. Reform incentives will be reduced inside the MU because the less “flexible” countries would like to keep the extra policy instrument to replace the loss of national monetary policy.

case that ECB is as conservative as the national central banks, then the fact that it cares about area-wide developments and does not accommodate regional imbalances, *reduces incentives for reform*. One more disincentive arises from the fact that labor market reform in an individual country has only a small effect on aggregate equilibrium unemployment and area-wide inflation, so each member state internalizes only a small part of the benefits from reform, while bearing all the cost of the national reform effort³.

The *aim of this paper* is to analyse the effect of EMU on governments' incentives to undertake labor market reform. It merges two strands of the literature. The first is related to the "time inconsistency" approach regarding incentives to undertake reform inside the EMU, whereas the second is related to the literature analyzing the interaction between EMU and wage bargaining. The model builds on the analysis of Calmfors (2001), Cukierman and Lippi (2000), Gruner and Hefeker (1999), and Hefeker (2000). Calmfors (2001) aims at analyzing the effects of the formation of the monetary union on governments' incentives to undertake reform, without considering explicitly the wage bargaining process. On the other hand, Cukierman and Lippi (2000), Gruner and Hefeker (1999) analyze the effects of EMU on inflation and unemployment in the context of decentralized and centralized wage bargaining without addressing the issue of labour market deregulation⁴. Hefeker (2000) examines the issue of labor market deregulation, however, in a case that it is determined solely by the national labor unions.

Hence, *distinct to the relevant previous literature*, this paper analyzes governments' incentives for reform in a simplified two-country monetary union where national labor markets are characterized by centralized wage bargaining, and explicitly models unions' behavior regarding labor market reform, as well as, its effects on governments' policies.

We assume that, before and after the MU has been formed, the labor union and the government behave as *Nash players* with respect to each other in the first stage of the game. The monetary policy has been delegated to an independent central bank. So, after the labor market institutions have been determined by the government and nominal wages have been set by the labor union, the

³Similar are the results of Sibert and Sutherland (2000). Labor market distortions lead policy-makers to inflate too much. The costly spillovers of uncoordinated monetary policy can be reduced by labor market reform. The authors suggest that reform is higher when there is no monetary policy cooperation, relative to the case where nations negotiate over monetary policy; this happens because cooperation reduces spillovers leading to fewer incentives for reform.

⁴Trade unions are assumed to care about inflation; this creates interdependencies between the real variables of the member states. Wage premiums above the competitive wage tend to be "strategic substitutes" leading to a moderating effect. However, in the MU more players interact, this reduces the impact of each union's wage decisions on the area wide inflation. So the MU can lead to more aggressive wage behaviour leading to higher unemployment and inflation, if unions' and CB's preferences are identical across countries before and after the MU [Cukierman & Lippi (2000), Gruner and Hefeker (1999)].

independent CB (or ECB in the MU case), which is expected to be credible, decides on monetary policy, and hence determines the inflation rate. The model is solved by backwards induction. The solution corresponds to the notion of subgame perfect Nash equilibrium⁵.

The outcome of this analysis is that contrary to what the “time-inconsistency” literature on labor market reform has suggested, incentives for reform will increase in the context of a MU, when governments and labor unions play Nash in the first stage of the policy game. In addition, in the context of the simple MU that we have introduced, which resembles the situation described by the “real effects” argument, labor market institutions will have a significant effect on each country’s economic performance. Moreover, a “race to the bottom” effect regarding deregulation is possible. Governments’ cooperation inside the MU can deal with this problem.

The paper is organized as follows: Section two presents the model (2.1-2.3). Section three discusses the possibility of governments’ cooperation in deciding on labor market reform. Finally, section four concludes.

2 The Model

We analyze two cases: (i) a representative country outside the MU, and (ii) a simple two-country MU. Product markets are assumed to be competitive and perfectly integrated; identical firms are assumed to produce the same homogeneous good. Following Calmfors (2001) and Sibert and Sutherland (2000) we assume that the government in a representative country cares not only about inflation and unemployment, but also about labour market institutions. The labor market is characterized by the presence of a monopolistic labor union (centralized wage bargaining-CWB); so the competitive outcome is not achieved (leading to unemployment and output loss), which creates an incentive for the government to inflate. This problem can be eliminated by undertaking labor market reform; which is assumed to be costly, because it affects employed insiders (the electorate in terms political economy models). The structural reform variable is assumed, in the Calmfors (2001) and Sibert and Sutherland (2000) spirit, to be a composite index that reduces labor market rigidities (including union bargaining power in the wage setting

⁵The *sequencing of the game* is justified as follows: monetary policy is decided in the last stage of the game since it can be changed very easily and quite often so as to address unfavorable economic conditions. Deregulation takes place at the same time (first stage) that wages are decided, and probably as often as the wage setting. The implicit assumption is that players (the government and labor union) have imperfect information about each others actions.

process) thus increasing employment⁶. The CWB assumption allows us to identify the effect of unions' behavior on governments incentives to undertake labor market reform.

2.1 Labor market institutions and monetary policy outside the MU

First we consider the case of a representative country that does not participate (alternatively, a representative country before joining the MU) in the monetary union. The model is developed in two stages. In the first stage the government and the national labor union play Nash against each other (move simultaneously). Union members will set nominal wages treating the actions of the government as given. The government will decide on reform taking nominal wages as given. Both the labor union and the government are Stackelberg leaders with respect to the CB, which moves in the second stage of the game and sets the rate of inflation.

In the spirit of Hefeker (2000), Sibert and Sutherland (2000) and Calmfors (2001), we formulate the unemployment equation as:

$$u = a(w - \pi - \delta r) \tag{1}$$

Lowercase letters denote natural logarithms . u is the deviation of the unemployment rate from the natural rate \bar{u} , which is normalized to one ($\bar{U} = 1$), so its logarithm is zero. w is the logarithm of nominal wages and π is the inflation rate which is defined as follows: $\pi = p - p_{-1}$, p is the log of the price level P , normalizing $P_{-1} = 1$, we have $p_{-1} = 0$, thus we get $\pi = p$. Hence we define $w - \pi$ as being real wages. We assume that there exists a level of reform \bar{R} corresponding to the current level of labor market institutions (related to the current amount of distortions in the labor market) which is normalized to 1, so that its log is zero. Hence $r = \ln R$, and can be thought of as a *composite index* representing the degree of labor market deregulation, and δ

⁶Although this way of modeling labour market reform is a strong simplification, nevertheless it captures the beneficial effects that labour market reform is expected to have on employment. This composite index r refers to employment increasing (across-the-board) reforms. Notice, however, that several types of reform regarding labour market institutions might have an ambiguous effect on unemployment. For example, stricter labour standards and/or employment protection legislation (EPL) is expected to lead to higher levels of long term unemployment, while it is possible to lower short term unemployment by reducing the flows into and out of unemployment (reducing the labour turnover). This means that lower levels of EPL might not lead to the expected outcome [Elmeskov et al (1998) suggest the opposite]. On the other hand, higher taxes on labour, that include payroll taxes, income taxes and consumption taxes increase the wedge between the real cost of a worker to an employer and the real consumption wage of the worker. Hence, lowering the tax wedge will result in lower labour costs in the long run and in lower unemployment. Unemployment is also increasing the more generous and long-lasting the unemployment benefit entitlements are. Hence reform aiming to reduce the generosity of social security system will reduce unemployment. Also strong labour unions are expected to raise unemployment, unless they co-ordinate with firms in the wage setting process. However, this is possible only in the case of external competitive pressure (see Nickell and Layard 1999, Elmeskov et al 1998).

is the impact of deregulation (we assume $\delta > 0$). Thus unemployment is increasing, above the natural rate of unemployment, as a function of the real wage $w - \pi$ and decreasing in the index r (i.e. deviation from current labor market institutions which are related to a certain amount of distortions; so if $r = 0$, no reform is undertaken, and distortions remain at the same level).

Such institutional reforms have been supported by OECD studies as means of reducing unemployment [e.g. Elmeskov et al (1998), OECD (2000)].

2.1.1 Stage 2: The Central Bank's problem

The monetary authority wants to minimize the deviations of inflation and unemployment from their target levels, assumed to be zero for simplicity. So the central bank is minimizing a standard quadratic loss function of the form:

$$L_{CB} = \frac{1}{2}[\pi^2 + \lambda_{CB}u^2] \quad (2)$$

λ_{CB} is the unemployment aversion parameter. We assume also that the central bank does not care directly about the level of labor market reform.

While setting π to minimize [2], the central bank takes as given the nominal wages and the level of reform, and takes into account unemployment determined by [1]. The central bank's reaction function⁷, is obtained after the CB has equalized the marginal benefits and the marginal costs of a higher inflation rate:

$$\pi = \frac{\lambda_{CB}a^2}{1 + \lambda_{CB}a^2}[w - \delta r] = \Phi[w - \delta r] \quad (3)$$

Notice that the reaction parameter of the central bank: $\Phi < 1$, thus the monetary policy is not fully accommodating union's nominal wage demands. Also notice that an increase in the level of reform lowers the inflation rate. Labor market distortions reduce output below its efficient level; this creates an incentive to the CB to raise inflation above its optimal level in order to boost real activity and reduce unemployment.

If the natural rate of unemployment (NRU) was assumed to be higher than zero and the CB was targeting an unemployment rate below that, then the model would have exhibited the Barro-Gordon inflation-bias. In that case, incorporating expected inflation and making use of the rational expectations assumption, reform would have reduced the inflation bias, and hence the

⁷The mathematical derivations are presented in more detail in the Appendix.

incentives to generate surprise inflation.

2.1.2 Stage 1: The Union and the Government play Nash

2.1.2.1 The Government

The government minimizes

$$L_G = \frac{1}{2}[\pi^2 + \lambda_G u^2 + \gamma r^2] \quad (4)$$

with respect to r , subject to (1) and (3), taking nominal wages set by the labor union as given. The fiscal authority wants to minimize the deviation of r , from current labor market institutions ($r = 0$). Hence, reform has a direct negative effect through r itself [because it is opposed by its electorate, the majority of the employed insiders according to Saint-Paul (1996)], and an indirect positive effect through lower inflation and unemployment. The government is assumed to care more about unemployment relative to the central bank $\lambda_G > \lambda_{CB}$.

The minimization problem yields a reaction function of the form:

$$r = f_G(w) \quad (5)$$

i.e. the reform undertaken by the government is an increasing function of the wages ($f'_G(w) > 0$) set by the union. In the absence of reform, the effect of labor market distortions (e.g. increased union power) leads to high wages and low labor demand, and thus to high unemployment. Hence, labor demand-enhancing reform should be undertaken (reduction of the union power), in order to shift the labor demand schedule outwards (so as to reduce unemployment and inflation), by eliminating labor market distortions. Reform is an increasing function of nominal wage demands by the union members, in order to outweigh the negative effect that unions' wage setting behavior has on unemployment (and its positive effect on inflation)⁸.

2.1.2.2 The Union

Employing the assumption that all national labor union members are identical and that firms produce a homogeneous good we can assume the presence of only one union in the economy. The single union that represents all workers in the economy prefers a higher real wage for its members, dislikes unemployment among its members, is inflation averse

⁸The government observes that an increase in reform reduces unemployment: $\frac{\partial u}{\partial r} = a\delta(\Phi - 1) < 0$, and inflation: $\frac{\partial \pi}{\partial r} = -\Phi\delta$. At the same time it knows that higher wages lead to higher unemployment: $\frac{\partial u}{\partial w} = a(1 - \Phi) > 0$ and higher inflation: $\frac{\partial \pi}{\partial w} = \Phi > 0$. So the government in order to reduce inflation and unemployment, sets reform as an increasing function of wages.

and opposes labor market reforms e.g. labor unions dislike reform/deregulation regarding labor market standards (e.g. parental leave mandates, mandatory sick pay, rules on working time, health and safety regulations, employee representation rights), as well as, less strict employment protection legislation [EPL-job security rules and regulations that concern administrative procedures (reasons for dismissal, length of notice of termination) severance payments, unfair and collective dismissals. Moreover, union members strongly averse any attempt by the government that reduces their bargaining power in the wage setting process⁹. Real wages and labor market reform enter separately in the loss function for the sake of simplicity (we could assume that the labor unions have targeted levels of labor market regulation regarding various labor market institutions but not for all [Calmfors (2001), Hefeker (2000)]). It is possible that in this centralized wage bargaining setting, the single union takes into account the effects of its action not only on real wages and employment of its members but also on the general inflation rate (Cukierman & Lippi 1999). Union members, like any one else in society, dislike inflation because it is quite possible that their pensions or other sort of savings are not fully indexed.

The labor union is minimizing the following loss function:

$$L_{LU} = -2(w - \pi) + Au^2 + B\pi^2 + \Gamma r^2 \quad (6)$$

with respect to nominal wages w , subject to (1) and (3) taking reform as given. A , B , and Γ are positive parameters representing the labor union's preferences.

The minimization problem yields the union's reaction function:

$$w = \frac{1 + \lambda_{CB}a^2}{Aa^2 + B(\lambda_{CB}a^2)^2} + \delta r \quad (7)$$

The union facing the possibility of labor market reform undertaken by the government, which will reduce its bargaining power in future periods, decides to react "aggressively" raising nominal wage demands. This can be seen as a reaction of union members in order to counterbalance the direct negative effect of reform on their welfare. The fact that the union increases wages ignoring their negative effect on unemployment implies that it attaches more weight on real wages i.e. $2 > A$. In addition, despite that the union perceives the positive effect of reform on reducing unemployment and inflation it opposes reform because it anticipates the lack of control in wage

⁹This sort of reform is opposed by union members because it directly reduces their welfare, since it implies a lack of control in future periods and that the union will diminish in size and influence (the UK experience in the 80s).

setting process in the future periods, which will imply lower wages (and possibly “union staff” being fired). The permanent effect will be the demise of unionization, which implies that the union will diminish in size and influence. Hence, it is assumed that an increase in reform has a very strong negative (positive) effect on unions welfare (loss), implying that Γ is very large (higher than the “normalized value” of 2 assigned on real wages)¹⁰.

Notice, also, that this setting provides support to the view that in centralized wage bargaining with a very inflation averse union that takes into account the effects of its actions the CB should be less conservative or “populist”. Specifically, the less conservative the central bank is (the higher λ_{CB}), the less the nominal wage demands of the union (appendix A.1.2.1); because it knows that the CB does not care much about inflation, and cares more about unemployment, which means that the CB will engage in expansionary monetary policy (increasing inflation) in order to deliver the targeted unemployment level. Hence, the union will internalize the effect of its actions and moderate wage demands to avoid a very inflationary outcome that erodes nominal wages¹¹.

2.1.2.2.1 Strategic complementarity The government and the union react “aggressively” in the face of more aggressive play by the other player, so we can say that reform and wages are “*strategic complements*”. The equilibrium nominal wages and the amount of reform are obtained by the intersection of the two reaction functions in the (w, r) space¹². So we get:

$$r^N = \delta \frac{\lambda_{CB}^2 a^2 + \lambda_G}{(\lambda_{CB} a^2 + 1) \gamma (A + B \lambda_{CB}^2 a^2)} \quad (8)$$

¹⁰Notice that higher reform implies lower inflation and unemployment. However, union’s aggressive behavior drives nominal wages up, which, offsets the negative effect of reform on inflation. Since inflation has not changed, real wages increase, leading to unchanged unemployment. So the union members reap short-term benefits from their aggressive wage setting behavior, but reform has long-lasting negative effects represented by the high value of Γ on their loss function.

¹¹Relevant literature like Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (1999), supports the view that if the union is inflation averse, only a “radical populist” or “ultra-liberal” central banker relative to society can achieve the first best solution of zero inflation and full employment. This is because real wage premiums decided by the union diminish as the union reacts to the CB’s increasing willingness to inflate in order to increase employment. So while inflation initially increases in low levels of CB’s conservatism, eventually it decreases because the populist CB is not interested in producing surprise inflation when the economy is approaching the full employment level. Guzzo and Velasco (1999) note that: “*Introducing a second distortion (opportunistic central bank behaviour) into an economy already distorted by monopolistic behaviour in the labour market can be welfare improving*”. However, Lippi (1999) has shown that this result does not hold in the case of multiple unions that determine their nominal wages.

¹²Welfare implications cannot be drawn from this framework. The only comment that we could make is that reform lowers union’s welfare by reducing their future bargaining power in the future. The government has to deal with strong opposition of reform (through unions wage setting behavior); as far as the reform effort leads to a demise of unionization in future periods, then unemployment and inflation would be lower (in the future).

$$w^N = \frac{\lambda_{CB}^2 a^4 \delta^2 + \gamma \lambda_{CB}^2 a^4 + 2\gamma \lambda_{CB} a^2 + \lambda_G a^2 \delta^2 + \gamma}{(\lambda_{CB} a^2 + 1) \gamma a^2 (A + B \lambda_{CB}^2 a^2)} \quad (9)$$

$$\pi^N = \frac{\lambda_{CB}}{A + B \lambda_{CB}^2 a^2} \quad (10)$$

$$u^N = \frac{1}{a (A + B \lambda_{CB}^2 a^2)} \quad (11)$$

$$w_r^N = \frac{\lambda_{CB}^2 a^4 \delta^2 + \gamma \lambda_{CB} a^2 + \lambda_G a^2 \delta^2 + \gamma}{(1 + \lambda_{CB} a^2) \gamma a^2 (A + B \lambda_{CB}^2 a^2)} \quad (12)$$

A graphical representation of this analysis, in (w, r) space, is presented in Figure 1. G and LU are the reaction functions of the government and the union ([5] and [7]), respectively. Point N represents the Nash solution¹³.

¹³Nested is a situation where the Government decides first on reform (Stackelberg leader) and then the Union sets nominal wages. The Stackelberg solution is represented by the intersection of the vertical axis (w-axis) with the LU curve. As we can see this delivers lower wage-reform combination relative to the Nash solution. However, the implicit assumption made by the sequencing structure in the Stackelberg case, is that the Government decides first and determines the institutional framework, anticipating the reaction of the Union to each reform level r that the Government might decide. Moreover, all previous moves are observed before the next is chosen. So complete and perfect information are assumed. For this reason we think that the Stackelberg case can be characterized as uninteresting because the real life determination of labor market institutions and nominal wages is much more complicated allowing for imperfect information among the players. This can be captured by the simultaneous move game structure.

Incomplete information is also possible, however not modelled here. In a complete information game all players's payoff functions are common knowledge. In a case of incomplete information at least one player is uncertain about the other player's payoff function.

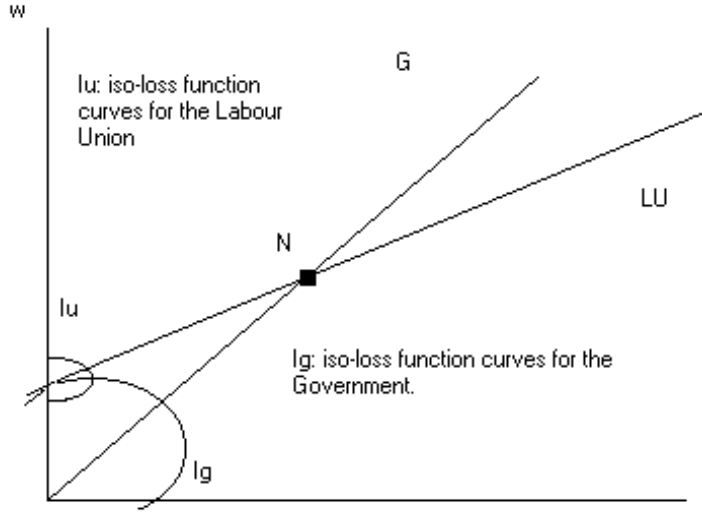


Figure 1: Nash Equilibrium Before the MU

2.2 Labor market institutions and monetary policy inside the MU

We now turn to examine the effect that the establishment of a monetary union¹⁴ might have on decisions regarding labor market reform, which are still taken by national governments in order to deal with the heterogenous labor market structures in each country. This is plausible, because there has not yet been developed, a coordinated strategy for employment among EU member states. The labor union in each country decides on nominal wages taking as given the nominal wage demanded in the other country. The common central bank (we call it for brevity ECB) determines the common inflation rate for all participating countries. We analyze a case of a two-country (1 and 2) monetary union, and we consider the benchmark case of two identical countries having identical unions. To focus on the direct effects of EMU we can also assume that $\lambda_{ECB} = \lambda_{CB}$, although it would probably be more realistic to consider the case where the ECB cares less about unemployment relative to the national central banks.

The unemployment equation is determined as follows:

$$u_{MU} = \frac{u_1 + u_2}{2} = a(w_{MU} - \pi_{MU} - \delta r_{MU}) \quad (13)$$

we have defined $w_{MU} = \frac{w_1 + w_2}{2}$, $r_{MU} = \frac{r_1 + r_2}{2}$, while we have assumed that the unemployment equation in each country i is defined as follows:

¹⁴In this benchmark case, abstracting from reality, we assume that the imposition of the MU can only be represented by the establishment of the common CB, which decides on the common inflation rate.

$$u_i = a(w_i - \pi_{MU} - \delta r_i) \quad (14)$$

i.e. it is affected by the nominal wage demands in country i , the common inflation rate in the monetary union and the reform undertaken in country i . We assume for simplicity that δ is identical across countries; however, it is more plausible that the same amount of reform across countries will lead to different effects in each country, because some countries are already characterized by more flexible labor market structures than others.

Notice that the simple MU case we are considering with the common inflation rate determined by the ECB, contrary to a situation where the ECB would care about a weighted average of the inflation rates in each member state (in case of non symmetric countries), could be thought of as the limiting case of the situation described by the “real effects” argument discussed in the introduction. It could be described as a world with economic stability, and increased economic integration, where product market competition has led to price convergence within the MU. In this context, national labor market institutions will have very important effects on member states’ economies.

2.2.1 Stage 2: The ECB’s problem

In stage 2 the European Central Bank determines the common inflation rate taking into account u_{MU} and taking as given the nominal wages set by the unions in the two countries, as well as, the amount of reform decided by the national governments in the first stage of the game¹⁵.

So the ECB is minimizing the following loss function with respect to π_{MU} , subject to (13):

$$L_{ECB} = \frac{1}{2}[\pi_{MU}^2 + \lambda_{ECB}u_{MU}^2] \quad (15)$$

So we can get the reaction function of the ECB which is defined in terms of area-wide variables:

$$\pi_{MU} = \frac{\lambda_{ECB}a^2}{1 + \lambda_{ECB}a^2}[w_{MU} - \delta r_{MU}] = \Phi_{ECB}[w_{MU} - \delta r_{MU}] \quad (16)$$

as in the case of national monetary policy the more reform results in lower area-wide inflation. We can see also that since $\lambda_{ECB} = \lambda_{CB}$, the ECB responds in the same way to an increase in the average nominal wages in the monetary union, as a national central bank would respond to an increase in nominal wage demands by the national union.

¹⁵The ECB cares only indirectly about labour market reform.

2.2.2 Stage 1: The Governments and the Unions play Nash

2.2.2.1 The Governments The national governments decide about the level of labor market reform in each country, subject to the ECB's reaction function, and taking as given the nominal wages set by the labor unions, as well as the amount of reform decided by the other government. Each national government in country i is minimizing the following loss function with respect to r_i :

$$L_{Gi} = \frac{1}{2}[\pi_{MU}^2 + \lambda_G u_i^2 + \gamma r_i^2] \quad (17)$$

subject to (16), and taking as given w_i , w_j and r_j . Notice that the two governments attach the same weights λ_G and γ on unemployment and reform, respectively. Reform has a direct negative effect on governments' decisions, as well as, an indirect positive effect through the reduction of unemployment and inflation, for the same reasons that were discussed in the case of a representative country outside the MU. So we get the reaction function for each government, which is:

$$r_i = f_{Gi}(r_j, w_i, w_j) \quad (18)$$

Examining the governments' reaction functions we can see that: Reform undertaken in country 1 is an increasing function of nominal wage demands in country 1 ($\frac{\partial r_1}{\partial w_1} > 0$, exactly for the same reasons analyzed in the case of a representative country outside the MU). Notice also that the higher the wages in the country 2, the less the reform undertaken in country 1 ($\frac{\partial r_1}{\partial w_2} < 0$), because a high w_2 will increase area wide inflation reducing, thus, unemployment in country 1 (by reducing real wages in country 1), leading to fewer incentives for reform.

On the other hand more reform in country 2 will induce the Government in country 1 to engage in more labor market reform ($\frac{\partial r_1}{\partial r_2} > 0$). This is a "*race to the bottom*" argument: a high r_2 (by increasing r_{MU}) reduces area- wide inflation, other things being equal, resulting in higher unemployment in country 1 (by increasing real wages in country 1). Thus reform has the effect of a "*beggar-thy-neighbor*" policy. So the government in country 1 decides to undertake reform in order to counterbalance this "*negative spill-over effect*". Hence we can postulate that the level of institutional reform of each country can be thought of being *strategic complement*, an argument that has not drawn much attention in the literature and can possibly shed some more light in the workings of a MU and the decisions to form and/or participate in a MU.

Strategic complementarity of institutional reform in the context of the perfectly integrated MU that we are considering, implies that member states' economics will incur "real effects" by the reform decision undertaken by each national government. In real life situations labor market institutions(LMI), by affecting labor costs, would be an important determinant for firms' decisions about foreign direct investment (FDI) in an environment of intensified product market competition. So government action would be important in attracting FDI, leading to negative side-effects to the other countries on the MU that are competing for FDI (originated from outside the MU). Additionally, other things being equal, LMI could be important factor in the relocation decisions of firms from on MU country to another, deteriorating the economy with the more "rigid" labor market.

2.2.2.2 The Unions The national unions, which are assumed to be identical regarding their preferences (same A , B and Γ) decide about nominal wages subject to the reaction function of the ECB, whereas take as given the level of reform decided by each government. We assume, also, that the national union in country i takes as given the level of nominal wages set by the national union in country j .

The national union in country 1 minimizes the following loss function with respect to w_1 :

$$L_{LU_1} = -2(w_1 - \pi_{MU}) + Au_1^2 + B\pi_{MU}^2 + \Gamma r_1^2 \quad (19)$$

subject to the common inflation rate π_{MU} , and taking as given w_2 and r_1, r_2 . From the first order condition, we get the following reaction function for each union:

$$w_i = f_{LU_i}(r_j, r_i, w_j) \quad (20)$$

The nominal wage set by each union is determined with respect to the nominal wage set by the union in the other country and the amount of reform determined by the national governments. If unions are very inflation averse (high B), or the common CB is not very conservative (high λ_{ECB}), a high nominal wage demand in country i moderates wage demands in country j , ($\frac{\partial w_j}{\partial w_i} < 0$) since the union in country j realizes the positive effect of higher wage demands on area wide inflation ("*moderating effect*"); on the other hand, if unions are not very inflation averse, they will respond by setting higher wages.

A higher level of employment enhancing reform in country j generates an aggressive wage setting reaction by the union in country j ($\frac{\partial w_j}{\partial r_j} > 0$). When unions are very inflation averse (or

the common CB is not very conservative (high λ_{ECB}), higher reform in country i raises nominal wage demands in country j ($\frac{\partial w_j}{\partial r_i} > 0$), generating a second channel of interaction that affects nominal wages positively (appendix A.2.1.1); otherwise, the effect of r_i on w_j is negative.

Combining the reaction functions of the two unions, and averaging we obtain¹⁶ the following average reaction function for the two labor unions :

$$w_{MU} = \frac{[1 - \frac{\Phi_{ECB}}{2}] Y}{N} + \delta r_{MU} \quad (21)$$

Comparing (21) with (7) we see that reform enters positively in the equation describing unions' wage setting behavior inside the MU. Notice that, as in the case of a representative country outside the MU, the large direct negative effect of reform on labor unions generates an aggressive wage reaction, which leads to higher real wages, while inflation and unemployment remain constant. In this way the unions try to counterbalance the welfare loss produced by the future reduction in their size and influence due to reform.

2.2.2.2.1 Strategic Interactions So far we have obtained a system of four equations with four unknowns (equations [18] and [20] for i and j), solving this we get the equilibrium solutions for wages and reform for each player, averaging we get the area-wide equilibrium solutions.(Appendix A.2.1.2).

Figure 2 presents graphically the results of the analysis. G and LU are the reaction functions of the government (eq.[5]) and the union (eq.[7]) in the representative country outside (before) the MU; GM and LUM represent, respectively, the so-called “average reaction functions” of the two governments and the two labour unions inside the MU; these can be constructed by [18] and [20]¹⁷.

The formation of the MU will move upwards the “average reaction function” of the unions, compared to the reaction function of the union in a representative country before the MU, however the slope will still be the same (δ). The interaction of more unions inside the MU, makes them internalize to a lesser extent the effects of their wage setting decisions. So despite the fact that unions are still inflation averse the moderating effect is not so strong any more. Moreover, even if unions average reaction to a given increase in average reform is the same (δ), the combined effect

¹⁶For country i we have: $w_i = \frac{[1 - \frac{\Phi_{ECB}}{2}] Y}{N} + \delta r_i$, where $Y = (1 + \frac{M}{N})$, $X = (1 - \frac{M^2}{N^2})$.

¹⁷Combine [18] for i and j and then average; in this way we get the so-called “average reaction function” of (average area-wide) reform in terms for (average area-wide) wages for the two governments. Similarly for the two unions using [20].

of higher nominal wage demands by both unions as a reaction to the higher reform level by the two governments leads to wages being higher inside the MU.

The “average reaction function” of the governments inside the MU will have smaller slope compared to the case of a representative country outside (before) the MU, so every wage level is related to more reform inside the MU. Moreover, a given increase in average wages will result to a stronger reaction, in terms of average reform, by the governments inside the MU. These effects are the outcome of the interaction of more players inside the MU. In particular, it is the outcome of (i) the “*strategic complementarity*” of labor market reform which leads to higher reform levels, and (ii) the aggressive reaction of governments in the face of more aggressive reaction by unions to the higher reform levels decided.

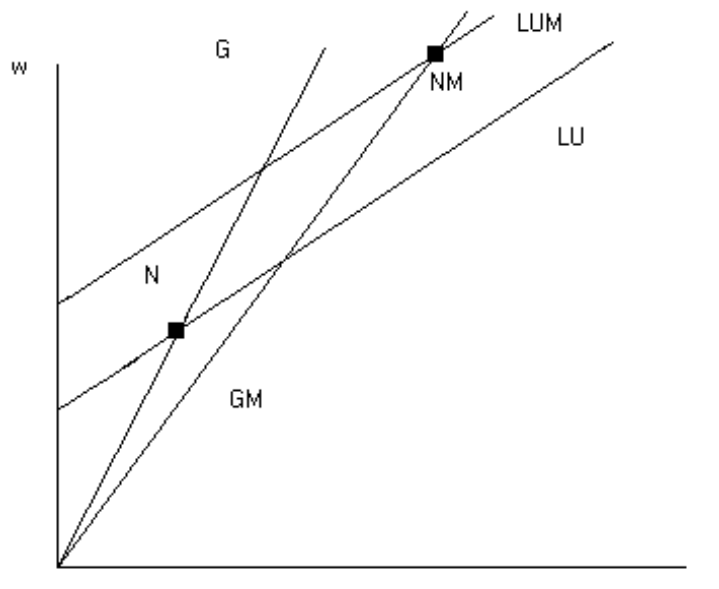


Figure 2: Nash solutions before and after the MU.

2.2.2.3 Summary of results:

2.2.2.3.1 Compare with the case of Nash play before MU:

- When the Governments and the Unions play Nash against each other inside the MU, take as given the reaction of the other player, and given that more players interact compared to the before-MU case, they internalize to a lesser extent the effects of their actions. Hence wages and reform determined in the first stage of the game are higher than in the case of a representative country outside the MU.
- The weakening of the moderating effect on unions’ nominal wage demands leads to higher

nominal wages, which outweigh the increase in reform levels resulting in higher inflation. In turn this leads to an increase in real wages, because the common central bank (as the national CBs) is not fully accommodating nominal wage demands. So inflation increases but not enough to avoid the negative effects on employment.

- National Governments have *more incentives to undertake costly reform in the context of a MU rather than outside the MU*. This is the outcome of the interaction of more players, inside the MU, that believe that their behavior will not affect to a great extent area wide variables. Specifically, when the size of a typical union (that cares about inflation) decrease, its perception of how much it can affect area-wide variables diminishes. National unions increase wages in case of higher reform in both countries; this triggers an aggressive reaction by each national government (however, not in the case of higher wages in the other country). This reaction is further amplified by the “*strategic complementarity*” of labor market institutions¹⁸. Thus reform levels will be higher inside the MU. This gives rise to the possibility that, inside the MU, there will be “*race to the bottom*” regarding labor market reform¹⁹.

3 Extensions

3.1 Cooperation between the fiscal authorities

We saw in the case of non-cooperative Nash play that incentives for reform are increased inside the MU. This was the outcome of unions’ aggressive reaction to more reform, that triggers governments’ aggressive reply to higher wages, as well as, of the “*race to the bottom*” effect. International co-ordination could deal with this problem. In this section we assume that it takes the form of cooperation between the two national governments inside the monetary union.

So in stage 1, the two governments co-operate with each other and play Nash against the unions, while the two unions play Nash both against each other and against the coalition of the two governments. In stage 2, the common CB sets area-wide inflation.

The governments are minimizing:

¹⁸Notice that two moderating effects are in action: the higher is w_j the lower are w_i and r_i . The first works through [20] and the second through [18]. However, these moderating effects are not sufficient to reverse the “chain reaction” that leads to higher wages and reform.

¹⁹International co-ordination could deal with this problem if regulations are desirable. On the other hand if regulations are excessive this competition could be beneficial, and governments’ incentives for reform will be increased (Andersen et al 2000, Bertola and Boeri 2001, etc).

$$G = (1 - \eta)\frac{1}{2}(\pi_{MU}^2 + \lambda_G u_1^2 + \gamma r_1^2) + \eta\frac{1}{2}(\pi_{MU}^2 + \lambda_G u_2^2 + \gamma r_2^2) \quad (22)$$

with respect to r_1 and r_2 , subject to π_{MU} set in stage 2, u_1 and u_2 , whereas taking as given nominal wages decided by the two unions (we assume for simplicity $\eta = \frac{1}{2}$).

The Union in country 1 minimizes: [19] with respect to w_1 subject to the common inflation rate π_{MU} , to u_1 , and taking as given w_2 and r_1, r_2 . Similarly for the union in country 2. Hence the reaction function for each union is still described by [20].

Figure 3 describes the effect of cooperation. The governments' "average reaction function"²⁰ of average reform to average wages has moved to the left of GM, and coincides with G (G=GMC). The new equilibrium outcome is at point NMC which is lower than NM, but still higher than N. The effect of governments' cooperation is to reduce their reaction to a given increase of wages, compared to the Nash play analyzed in Section 2.2 (bigger slope for GMC relative to GM). In addition, as we saw before, the reform level that corresponds to each wage level is lower for G relative to GM. Accordingly this will induce less aggressive wage setting behavior by national labor unions. Furthermore, the cooperation is beneficial because each government will internalize the negative effects of its actions on the other government.

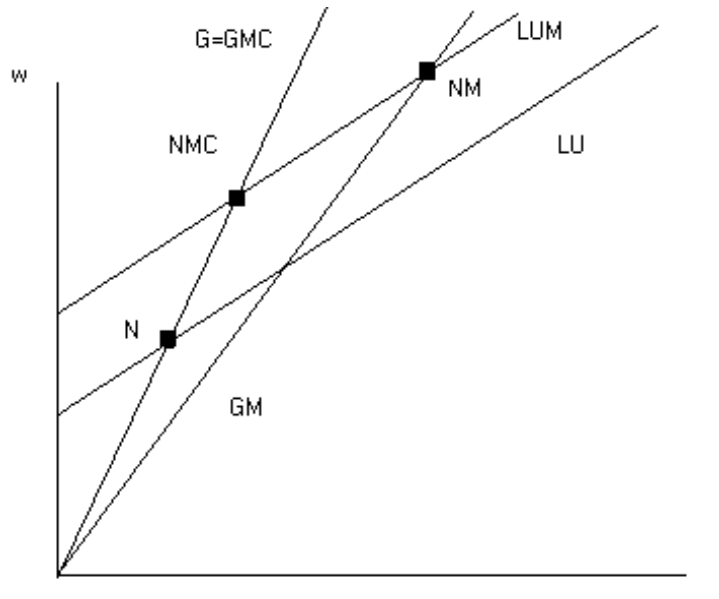


Figure 3: The effect of Governments' cooperation in the MU.

²⁰The mathematical derivations and the equilibrium solutions are presented in Appendix A.3.

3.1.1 Summary of results:

- *Governments' cooperation* inside the MU can moderate the effects of the “race to the bottom” deregulation, that arises due to the *strategic complementarity* of institutional reform. Furthermore induces unions to lower their nominal wage demands. This leads to lower real wages compared to the Nash-play case.
- Inflation and unemployment will remain at the same levels as before the cooperation of the fiscal authorities.

4 Conclusions

In this paper we have been able to merge the literature on the effects of a MU on labor market reform, with the literature examining the effects of a MU on inflation and unemployment under different wage bargaining structures. We have analyzed the effect of unions' behavior on governments' incentives for labor market reform before and after a monetary union has been imposed; with national labor markets characterized by centralized wage bargaining. We have examined a benchmark case of a two-country monetary union, with identical countries and identical national labor unions.

Incentives for reform are enhanced in the case where governments and unions engage in non-cooperative Nash play. This can be attributed to the interaction of more players inside the MU. Specifically, when the size of a typical union (that cares about inflation) decrease, its perception of how much it can affect area-wide variables diminishes. Unions adopt a very aggressive attitude towards reform in the MU. Governments, in turn, react to this aggressive behavior, while they also engage in a “beggar-thy-neighbor” deregulation, that could lead to a “race to the bottom” effect. This problem is moderated when the two national governments decide to cooperate in setting reform, so as to internalize the externalities that produce to each other. This will also lead to wage moderation by the unions.

So despite the fact that the shift in the monetary regime is only captured by the establishment of the common central bank which decides on common inflation rate, without altering unions' behavior, we were able to describe real-life situation that could lead to increased incentives for labor market reform in the MU context²¹. More elaborate arguments have been used in the

²¹Note, however, under the current arrangement regarding the formation of the MU labor market institutions play a very important role on the economies of the member states.

literature in order to produce a similar result. Sibert (1999) argues that in the presence of coordination of monetary policy before the MU, that takes the form of *side payments* to the countries suffering from high inflation bias, incentive for reform will be higher inside the MU²². Moreover, Calmfors (1998a) shows that there will be more labor market reform within the EMU if national governments have a precautionary motive for reform and there is no inflation-bias problem.

Additional findings of the model are in accordance with what the relevant literature has suggested. For example, in the case of the representative country outside the monetary union, our results are in favor of a less conservative or “populist” central bank. In the participation in the MU case, our results support the view that nominal wages and inflation will be higher relative to the non-participation in the MU case, because the unions rationally internalize less the effects of their actions, raising unemployment and real wages (since the common CB is not willing to fully accommodate nominal wage demands).

Several aspects of this issue are not studied here, and are left for future research. First the effect of cooperation among governments and unions in deciding the institutional framework could be also examined, because it resembles to a “Social Pact”. Second, we can examine the case of unions’ cooperation inside the MU. Preliminary results suggest that if national labor unions cooperate in deciding their nominal wage demands while playing Nash with respect to the two-national governments then nominal, real wages and reform are at their lowest level compared with the cases mentioned before (but still higher than the “before the MU” case). Whereas inflation and unemployment are exactly at the “before the MU” levels. This happens because the externalities produced by the unions’ “aggressive” nominal wage setting behavior are relinquished. Notice, however, that this situation is far from being the case in Europe, despite the fact some big labor unions have already been engaged in talks.

Third, we can examine the effect of labor markets characterized by decentralized wage bargaining. The case of asymmetric countries can also be examined; these could have different impact of reform coefficient, different wage bargaining structures, etc. Another possible extension will be to model the coordination of monetary policy in the pre-MU case. There is, also, scope for future

²²Sibert (1999), argues, in a similar setting with Sutherland & Sibert (2000), that the negative externalities of inflation before the MU, are addressed by coordination of the monetary policy, with high regulated markets, suffering from high inflationary bias, receiving *side payments* so as not to pursue expansionary monetary policies. However, this creates an incentive for governments not to undertake the amount of reform required so as get higher subsidies; this disincentive is absent inside the MU because the common central bank is managing the area-wide monetary policy.

research relating to the effects of economic integration (increased product market competition) on incentives for labor market reform not captured in this framework of analysis, whereas political economy perspectives of reform inside the MU could also be studied in the future.

A Appendix

A.1 Outside the MU case

A.1.1 Stage 2: The Central Bank's Problem.

Minimizing (2) with respect to π taking into account (1), and then solving the first order condition with respect to π we get (3). From (3) we get:

$$\frac{\partial \pi}{\partial r} = -\Phi \delta < 0$$

Notice also that, for a given $[w - \delta r] > 0$, an increase in the degree of unemployment aversion (i.e. a less conservative central bank) will result in a higher inflation rate (this is considered to be a standard result in the literature). Also:

$$\frac{\partial \pi}{\partial \lambda_{CB}} = \frac{a^2}{(1 + \lambda_{CB} a^2)^2} [w - \delta r] > 0$$

A.1.2 Stage 1:

A.1.2.1 Labor Union's problem The minimization problem of [6] under the constraints [1] and [3] yields a first order conditions which is solved with respect to w leading to [7]. From (7) we have:

$$\frac{\partial w}{\partial r} = \delta$$

and we also obtain:

$$\frac{\partial w}{\partial \lambda_{CB}} = \frac{(A - 2B\lambda_{CB} + B\lambda_{CB}^2 a^2)}{[A + B\lambda_{CB}^2 a^2]^2} < 0$$

which is negative if $B > \frac{A}{\lambda_{CB}(2 + \lambda_{CB} a^2)}$, i.e. the union is quite inflation averse or the CB is not very conservative.

A.1.2.2 Government's problem Government's reaction function (G) is as follows:

$$r = (\lambda_{CB}^2 a^2 + \lambda_G) a^2 w \frac{\delta}{\lambda_{CB}^2 a^4 \delta^2 + \lambda_G a^2 \delta^2 + \gamma + 2\gamma \lambda_{CB} a^2 + \gamma \lambda_{CB}^2 a^4}$$

First we solve for wages, and then we find:

$\frac{\partial w_g^N}{\partial r} = o^B$. From union's reaction function (LU) we have: $\frac{\partial w_U^N}{\partial r} = \delta$, we know that $o^B > \delta$. So the effect of an increase in r , by one unit, on wages is much bigger for the government compared to the union, in the (w,r) space. So the slope of the government's reaction function is bigger than the slope of the union's reaction function. Notice that $o^B \leq \delta$ would imply that the two reaction functions do not intersect, something that by assumption is not considered to be the case.

A.2 Inside the MU case

A.2.0.3 Stage 2: The ECB's problem ECB is minimizing (15) with respect to π_{MU} , subject to (13). This leads to the following first order condition:

$$\frac{\partial L_{ECB}}{\partial \pi_{MU}} = \pi_{MU} - \lambda_{ECB} [a^2 (w_{MU} - \pi_{MU} - \delta r_{MU})] = 0$$

solving for π_{MU} we get (16).

A.2.1 Stage1

A.2.1.1 The Unions' problem In stage 1 the national union in country 1 is minimizing (19) with respect to w_1 , subject to (16), (14). The first order condition obtained is:

$$-1 + \frac{\partial \pi_{MU}}{\partial w_1} + Aa^2(w_1 - \pi_{MU} - \delta r_1) - Aa^2(w_1 - \pi_{MU} - \delta r_1) \frac{\partial \pi_{MU}}{\partial w_1} + B\pi_{MU} \frac{\partial \pi_{MU}}{\partial w_1} = 0$$

This yields [20], the reaction function of the two unions (i, j) ²³:

$$w_j = \frac{[1 - \frac{\Phi_{ECB}}{2}]}{N} + w_i \frac{M}{N} + \delta r_j - \delta r_i \frac{M}{N}$$

If $B > Aa^2(\frac{2}{\Phi_{ECB}} - 1) = A\frac{2+\lambda_{ECB}a^2}{\lambda_{ECB}}$, $[M < 0]$ i.e. unions are very inflation averse, or the common CB is not very conservative, a high nominal wage demand in country i moderates wages

²³ $N = Aa^2(1 - \frac{\Phi_{ECB}}{2})^2 + B\frac{\Phi_{ECB}^2}{4}$, $M = Aa^2\frac{\Phi_{ECB}}{2}(1 - \frac{\Phi_{ECB}}{2}) - B\frac{\Phi_{ECB}^2}{4}$.

demands in country j since the union in country j realizes the positive effect of higher wage demands on area wide inflation, in that case:

$$\frac{\partial w_j}{\partial w_i} = a^2 \lambda_{ECB} \frac{-B\lambda_{ECB} + 2A + Aa^2\lambda_{ECB}}{Aa^4\lambda_{ECB}^2 + 4Aa^2\lambda_{ECB} + B\lambda_{ECB}^2 a^2 + 4A} < 0$$

otherwise, if unions are not very inflation averse, the opposite holds. Also we get that: $\frac{\partial w_j}{\partial r_j} = \delta > 0$. Higher levels of reform in country j increase labour demand leading to higher wage demands by the union in country j . Moreover:

$$\frac{\partial w_j}{\partial r_i} = -\delta \frac{M}{N} = -\lambda_{ECB} a^2 \delta \frac{-B\lambda_{ECB} + 2A + Aa^2\lambda_{ECB}}{Aa^4\lambda_{ECB}^2 + 4Aa^2\lambda_{ECB} + B\lambda_{ECB}^2 a^2 + 4A} > 0$$

this is positive if $B > A \frac{2+\lambda_{ECB}a^2}{\lambda_{ECB}}$, either unions are very inflation averse or the common CB is not very conservative.

The explanation for this effect is as follows: a higher r_i increases r_{MU} , which results in lower π_{MU} (1st effect: $-\frac{\delta\Phi}{2}$). However, it also leads to a higher w_i . This now has two effects: on the one hand it leads to higher w_{MU} , which results in the higher π_{MU} (2nd effect: $\frac{\delta\Phi}{2}$). On the other hand it leads to lower w_j through the moderation effect described earlier, and this also reduces area wide nominal wages and inflation (3rd effect: $-\frac{\Phi\delta M}{2N}$). The first and the second effect cancel out; so a higher r_i reduces w_j and π_{MU} . The effect for real wages in country j is: $\frac{\delta M}{N}(1 - \frac{\Phi}{2}) < 0$, since we have assumed that $M < 0$. So union members in country j will raise their wage claims to compensate for the decrease in their real wages.

A.2.1.1.1 Reaction Functions The reaction functions are:

$$\text{Governments: } r_i = \delta \frac{\Phi_{ECB}^2 w_i + \Phi_{ECB}^2 w_i + \lambda_G a^2 \Phi_{ECB}^2 w_i - \Phi_{ECB}^2 \delta r_j - 4\lambda_G a^2 w_i \Phi_{ECB}}{\Phi_{ECB}^2 \delta^2 + \lambda_G a^2 \Phi_{ECB}^2 \delta^2 - 4\lambda_G a^2 \Phi_{ECB} \delta^2 + 4\lambda_G a^2 \delta^2 + 4\gamma}$$

$$+ \delta \frac{4\lambda_G a^2 w_i + \lambda_G a^2 \Phi_{ECB}^2 w_j - 2\lambda_G a^2 \Phi_{ECB} w_j - \lambda_G a^2 \Phi_{ECB}^2 \delta r_j + 2\lambda_G a^2 \Phi_{ECB} \delta r_j}{\Phi_{ECB}^2 \delta^2 + \lambda_G a^2 \Phi_{ECB}^2 \delta^2 - 4\lambda_G a^2 \Phi_{ECB} \delta^2 + 4\lambda_G a^2 \delta^2 + 4\gamma}$$

$$\text{Unions: } w_i = - \left(\frac{-4 + 2\Phi_{ECB} - B\Phi_{ECB}^2 \delta r_j + 4Aa^2 \Phi_{ECB} \delta r_i - Aa^2 \Phi_{ECB}^2 \delta r_i - 2Aa^2 \Phi_{ECB} w_j}{Aa^2 \Phi_{ECB}^2 - 4Aa^2 \Phi_{ECB} + B\Phi_{ECB}^2 + 4Aa^2} + \frac{Aa^2 \Phi_{ECB}^2 w_j - 4Aa^2 \delta r_i + 2Aa^2 \Phi_{ECB} \delta r_j - Aa^2 \Phi_{ECB}^2 \delta r_j + B\Phi_{ECB}^2 w_j - B\Phi_{ECB}^2 \delta r_i}{Aa^2 \Phi_{ECB}^2 - 4Aa^2 \Phi_{ECB} + B\Phi_{ECB}^2 + 4Aa^2} \right)$$

From the governments' reaction functions we have:

$$\frac{\partial r_i}{\partial w_i} > 0, \frac{\partial r_i}{\partial w_j} < 0, \frac{\partial r_i}{\partial r_j} > 0. \text{ The last two hold as long as } \lambda_G > \frac{\lambda_{ECB}}{\lambda_{ECB} a^2 + 2}, \text{ which is true since}$$

$$\lambda_G > \lambda_{ECB} > \frac{\lambda_{ECB}}{\lambda_{ECB} a^2 + 2}.$$

A.2.1.1.2 The equilibrium solutions are: $r^{NMU} = \frac{1}{2} \delta \frac{\lambda_{ECB}^3 a^4 + \lambda_G a^4 \lambda_{ECB}^2 + 2\lambda_{ECB}^2 a^2 + 4\lambda_G a^2 \lambda_{ECB} + 4\lambda_G}{(B\lambda_{ECB}^2 a^2 + Aa^2 \lambda_{ECB} + 2A)\gamma(1 + \lambda_{ECB} a^2)}$

$$w^{NMU} = \frac{1}{2} \frac{\lambda_{ECB}^3 a^6 \delta^2 + \lambda_{ECB}^2 a^6 \lambda_G \delta^2 + 2\lambda_{ECB}^2 a^4 \delta^2 + 4\lambda_{ECB} a^4 \lambda_G \delta^2}{(B\lambda_{ECB}^2 a^2 + Aa^2 \lambda_{ECB} + 2A)a^2 \gamma(1 + \lambda_{ECB} a^2)}$$

$$\begin{aligned}
& + \frac{1}{2} \frac{10\lambda_{ECB}a^2\gamma + 8\lambda_{ECB}^2a^4\gamma + 2\lambda_{ECB}^3a^6\gamma + 4\lambda_G\delta^2a^2 + 4\gamma}{(B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A)a^2\gamma(1 + \lambda_{ECB}a^2)} \\
u^{NMU} &= \frac{\lambda_{ECB}a^2 + 2}{a(B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A)} \\
\pi^{NMU} &= (\lambda_{ECB}a^2 + 2) \frac{\lambda_{ECB}}{B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A} \\
w_r^{NMU} &= \frac{1}{2} \frac{\lambda_{ECB}^3a^6\delta^2 + \lambda_{ECB}^2a^6\lambda_G\delta^2 + 2\lambda_{ECB}^2a^4\delta^2 + 4\lambda_Ga^4\lambda_{ECB}\delta^2}{(B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A)a^2\gamma(1 + \lambda_{ECB}a^2)} \\
& + \frac{1}{2} \frac{6\gamma\lambda_{ECB}a^2 + 2\lambda_{ECB}^2a^4\gamma + 4\lambda_Ga^2\delta^2 + 4\gamma}{(B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A)a^2\gamma(1 + \lambda_{ECB}a^2)}
\end{aligned}$$

A.2.1.1.3 Figure 2: Comparing the intersection points of the w-axis with LUM (w^{SMU}) and LU (w^S) respectively we see that²⁴: $w^{SMU} > w^S$. From [18], we can get the “average reaction function” of average reform in terms of average wages, for the two Governments: combine [18] for i and j , and then average. Next we compute: $\frac{\partial w_g^{NMU}}{\partial r} = o^{MU}$ (similarly for unions using [20]).

Notice that the slope of the average reaction function for the unions is still δ . Comparing with the slope of the government’s reaction function before the MU (o^B), we see that: $\delta < o^{MU} < o^B$. For $o^{MU} \geq o^B$, we should be violating our assumptions: $\gamma > 0, \lambda_{ECB} > 0, a > 0, \lambda_G > \lambda_{ECB}$.

A.3 Cooperation of Fiscal Authorities

A.3.1 Equilibrium solutions:

$$\begin{aligned}
u^{MUGC} &= \frac{1}{a} \frac{\lambda_{ECB}a^2 + 2}{B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A} \\
\pi^{MUGC} &= \lambda_{ECB} \frac{\lambda_{ECB}a^2 + 2}{B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A} \\
w^{MUGC} &= \frac{4\lambda_{ECB}^3a^4\gamma + \lambda_{ECB}^2a^4\lambda_G\delta^2 + 2a^2\lambda_G\delta^2 + 5\lambda_{ECB}a^2\gamma + \lambda_{ECB}^3a^6\gamma + 2\gamma + 2\lambda_{ECB}^2a^4\delta^2 + \lambda_{ECB}^3a^6\delta^2}{(B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A)a^2\gamma(1 + \lambda_{ECB}a^2)} \\
r^{MUGC} &= \delta \frac{\lambda_{ECB}a^2\lambda_G + 2\lambda_G + \lambda_{ECB}^3a^4 + 2\lambda_{ECB}^2a^2}{(B\lambda_{ECB}^2a^2 + Aa^2\lambda_{ECB} + 2A)\gamma(1 + \lambda_{ECB}a^2)}
\end{aligned}$$

A.3.1.1 Figure 3: We can find the reaction function of governments’ coalition of average reform to average wages as follows: solve $\frac{\partial G}{\partial r_1} = 0$ with respect to r_1 , and $\frac{\partial G}{\partial r_2} = 0$ with respect to r_2 , average, and then solve with respect to wages; its slope is: $\frac{\partial w_{gc}}{\partial r} = o^{MUGC} = o^B > \delta$. So we have: $\delta < o^{MU} < o^{MUGC} = o^B$.

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²⁴These points correspond to the Stackelberg solution of the game where the Government moves first with respect to the union. This case has been not considered as being not realistic as discussed before.

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