

The welfare effect of switching from a floating exchange rate regime to a monetary union with non-atomistic wage setters*

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Abstract

How does a switch from national monetary policies (NMP) to a monetary union (MU) affect welfare? I address this question in a two-country general equilibrium model with large wage setters. The analysis shows that the unions' perception of the terms of trade movement is substantially different under either monetary regime. In a MU each union anticipates its wage claim not causing any terms-of-trade movements, while under NMP it leads to an improvement in the terms of trade. In contrast with recent studies, the formation of a MU is hence welfare improving by eliminating the incentive to strategically use the terms of trade. Finally, the paper extends Lippi's (2003) findings about the real effects of a conservative central bank (CB) and centralized wage setting into a flexible exchange rate regime with two independent CBs.

Keywords: Central bank conservatism, centralized wage setting, open-economy macro, monetary regime

JEL: E42, E58, F33, F41, J51

1 Introduction

Strategic monetary policy models with non-atomistic wage setting highlight that the establishment of a monetary union (MU) reduces the extent to which each union internalizes the inflationary repercussions of its wage demands (Soskice and Iversen, 1998; Cukierman and Lippi, 2001; Cavallari, 2004). In particular, a monetary regime change, as for example the creation at the beginning of 1999 of the Economic and Monetary Union (EMU) in Europe, alters *per se* the perceived labor demand faced by the unions and, therefore, employment. Intuitively, when nominal wage contracts are signed, the common central bank (CB) has an incentive to contract so as to reduce inflation. Unions internalize the general equilibrium

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consequences of their choices anticipating that labor demand is positively related to the economy's production scale which, in turn, depends on monetary policy. Thus, since monetary policy response toward wages hinges on the inflationary cost of wage hikes, a lower internalization of such costs on the part of unions leads them to perceive a more expansive monetary policy and, therefore, a less elastic labor demand. In this respect, two strategic mechanisms have been explored in the literature.¹

The first effect focuses on the imperfect substitutability between the demand for labor types, and is hence labeled "substitution effect". Cukierman and Lippi (2001) show that, in a MU, unions internalizes less the repercussions of their own actions on the aggregate wages, i.e. on other unions' wages, through a steeper aggregate labor demand. It turns out that the switch from national monetary policies (NMP) to a MU is likely to raise unemployment because each individual union perceives to improve its relative wage to a larger extent. The second effect, instead, studies the direct impact of a wage claim on aggregate labor demand, and is labeled "output effect". Soskice and Iversen (1998) argue that the establishment of a MU regime has negative effects on economic performance because each union anticipates that its wage demand has a limited effect on the union-wide inflation level and, hence, on the monetary wage response policies.

Either effect, singularly considered, indicates that the formation of a MU raises the monopolistic power of unions and the equilibrium unemployment level. However, when they are both nested within a model, the real effects of moving from NMP to a MU regime can be ambiguous. In this respect, Cavallari (2004) uses an open economy version of Lippi (2003), featuring both substitution and output effects, and shows that the formation of a MU is not necessarily detrimental. Intuitively, the lower perception on the part of unions of the inflationary consequences of their wage claims due to the MU regime leads, on the one hand, to a higher impact on aggregate real wage (i.e. on aggregate output), but, on the other hand, to a higher real wage relative to the other unions (i.e. a higher relative wage). Thus, the output and substitution effects entail two opposite incentives to nominal wage demands. In particular, Cavallari (2004) finds that a common monetary policy can be desirable when the output effect prevails on the substitution effect.²

A shortcoming of this literature is that the argument on the MU regime hinges only on strategic interaction between wage setters and a single monetary authority without considering the possibility for domestic unions of affecting the foreign labor market via an adverse "beggar-thy-neighbor" effect. The main reason is that Cukierman and Lippi's (2001) and Soskice and Iversen's (1998) findings under NMP are derived in a closed economy setup. Cavallari (2004), instead, allows for a two-country open economy setup under NMP, but domestic unions do not internalize the impact of their wage demand on the foreign monetary policy and, therefore, on the foreign labor market.

This paper adds to the above literature in two respects. First, it investigate in a micro-founded model a third channel through which a monetary regime shift can affect welfare: the unions' strategic use of

¹Grüner and Hefeker (1999) consider a single monopoly union in each country which is inflation averse *per se*. A MU regime has real effects in their model through this channel. In the paper, however, I will focus on standard unions' preferences without allowing for money illusion.

²See Cukierman (2004) for a recent survey on this issue.

the terms of trade.³ As noted by Corsetti and Pesenti (2001), under non-cooperative NMP, monetary authorities have an incentive to contract their money supply in order to improve the terms of trade. I show that under NMP not only have CBs an incentive to improve the terms of trade, but unions are also induced to strategically move the terms of trade. Since both domestic and foreign monetary policies are common knowledge for wage setters, a domestic wage increase improves the terms of trade through the asymmetric monetary policy responses toward domestic wages in the two countries. Thus, increasing the purchasing power of domestic residents, a terms of trade improvement leads also to a more aggressive wage demand. But this effect only operates under NMP. In a MU, in fact, the common CB internalizes the externalities stemming from the terms of trade, and unions perceive wage hikes as not producing any terms-of-trade modification because of the symmetric wage response policy in the two countries. As a result, the formation of a MU regime leads to wage moderation relative to NMP because of the disappearance of the terms-of-trade effect.⁴

Second, it extends Lippi's (2003) closed-economy analysis of the welfare effects of a conservative CB and centralized wage setting to a flexible exchange rate regime with two independent CBs. By nesting the three channels described above within an open-economy framework, this model identifies a different condition determining the sign of the impact of conservatism and centralization in wage setting on employment and welfare. More specifically, under a NMP regime, this condition is modified so as to allow for the strategic impact of wage setting on the terms of trade, while under a MU regime it coincides with the Lippi's requirement. Intuitively, from a strategic viewpoint, a common CB has the same effect on wage setting of a national monetary policy operating in a closed economy, whereby an individual union perceives to affect neither the terms of trade nor the exchange rate. Therefore, the only effects operating in a MU regime are the substitution and output effects.

The paper is organized as follows. The model is presented in Section 2, and Section 3 discusses the efficient allocation and the macroeconomic interdependencies under the two alternative monetary regimes. Section 4 presents the monetary policies under either regime, and Section 5 studies the wage setting. Section 6 details the welfare results of a switch from NMP to a MU regime, while Section 7 focuses on the real effects of CB conservatism and centralized wage setting. Section 8 concludes.

2 Economic setup

Building on Lippi (2003), I analyze the strategic interactions between monetary policy and non-atomistic wage-setting decisions in a micro-founded framework. I extend his model to a two-country general equilibrium model with nominal rigidities and monopolistic competition in line with the new open economy macroeconomics literature (e.g. Corsetti and Pesenti, 2001; Benigno, 2002).

³In a first generation of game-theoretic models *à la* Canzoneri and Henderson (1988), Jensen (1993) shows that the real exchange rate appreciation drives a wedge between the consumption and production real wage, thereby inducing unions to be more aggressive in their wage requests.

⁴There is evidence that inflationary pressures stemming from the labor markets have remained moderate since the formation of the EMU in Europe (European Commission, 2007).

The economy consists of two equally-sized countries, Home (H) and Foreign (F). Each country is specialized in the production of a single traded good, and inhabited by a continuum of agents (with population size normalized to 1) and a finite number of unions. I assume no impediments or costs to trade across borders. Production of the Home (Foreign) good requires a continuum of differentiated labor inputs indexed by $[0, 1]$ and supplied by Home (Foreign) agents.

Wages are contractually fixed for one period (contract period). The assumption of sticky wages allows monetary policy to affect real variables at least in the contract period. Specifically, I assume that at the beginning of the contract period, monopolistic unions simultaneously set nominal wages in their country of origin. Next, monetary policy is conducted under non-cooperative NMP or in a MU regime. The prevailing monetary regime is always known to unions when setting their wages. Finally, firms hire labor.

2.1 Firms

Let Y and Y^* denote output per capita in the Home and Foreign country respectively.⁵ Technology is described by the following production functions in the two countries:

$$Y = L^\alpha \quad ; \quad Y^* = (L^*)^\alpha \quad 0 < \alpha < 1, \quad (1)$$

where labor indexes L and L^* are Dixit-Stiglitz aggregators defined over the quantities hired of each differentiated labor type

$$L = \left[\int_0^1 L(j)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\sigma}{\sigma-1}} \quad ; \quad L^* = \left[\int_0^1 L^*(j^*)^{\frac{\sigma-1}{\sigma}} dj^* \right]^{\frac{\sigma}{\sigma-1}} \quad \sigma > 1. \quad (2)$$

Domestic firms act competitively, while each economic agent is a monopolistic supplier of one type of labor input.⁶ For a given level of production, the demand for labor type j solves the dual problem of minimizing total cost, $\int_0^1 W(j)L(j)dj$, subject to the employment index (2):

$$L(j) = \left[\frac{W(j)}{W} \right]^{-\sigma} L \quad ; \quad L(j^*) = \left[\frac{W^*(j^*)}{W^*} \right]^{-\sigma} L^*, \quad (3)$$

where $W(j)$ denotes the nominal wage of labor type j and W is the nominal wage index defined as

$$W = \left[\int_0^1 W(j)^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}} \quad ; \quad W^* = \left[\int_0^1 W^*(j^*)^{1-\sigma} dj^* \right]^{\frac{1}{1-\sigma}}. \quad (4)$$

These wage indexes have the property that the minimum cost of employing an array of labor types $L(j)$ is given by WL . Therefore, from profit maximization, aggregate labor demands are given by

⁵Henceforth, Foreign variables will be indicated by “*”.

⁶The paper results are not affected by the assumption of monopolistic competition in the product market. Proof available upon request.

$$L = \left[\frac{1}{\alpha} \frac{W}{P_H} \right]^{-\frac{1}{1-\alpha}} \quad ; \quad L^* = \left[\frac{1}{\alpha} \frac{W^*}{P_F^*} \right]^{-\frac{1}{1-\alpha}}. \quad (5)$$

2.2 Households

Utility of a representative Home agent $j \in [0, 1]$ is defined over consumption (C), labor (L), and real money balances (M/P):

$$U(j) = \log C(j) - \frac{k}{2} [\log L(j)]^2 + \log \left(\frac{M(j)}{P} \right) \quad k > \alpha, \quad (6)$$

where k is a positive preference parameter.⁷ For any person j the overall consumption index, C , is a Cobb-Douglas aggregator over the two available types of goods, i.e. the Home and Foreign goods:

$$C = 2C_H^{1/2} C_F^{1/2}. \quad (7)$$

C_H and C_F are consumption of the Home-produced traded good and of the Foreign-produced traded good respectively. The consumption-based price index expressed in domestic currency is defined as

$$P = P_H^{1/2} P_F^{1/2}, \quad (8)$$

where P_H and P_F are the prices of Home and Foreign goods in Home currency. Foreign agents are modeled in an analogous way.

In the absence of market segmentation across countries, the law of one price holds:

$$P_F = E P_F^* \quad ; \quad P_H^* = P_H / E, \quad (9)$$

where E is the nominal exchange rate (domestic currency per unit of foreign currency), and P_H^* and P_F^* are the prices of Home and Foreign goods in Foreign currency.

The Home commodity demand functions resulting from cost minimization imply

$$P_H C_H = P_F C_F = \frac{1}{2} P C, \quad (10)$$

i.e. one half of household expenditure is spent on each tradeable good.

⁷In order to have a utility function decreasing and concave in equilibrium leisure, the assumption $k > \alpha$ must hold (see eqs. (24) and (53)).

2.3 Asset markets and budget constraints

Each j -th individual owns equal shares of all domestic firms and of an initial stock of the domestic currency. Markets are complete domestically and international equity trade is forbidden.⁸

A typical Home agent j maximizes (6) with respect to $C(j)$ and $M(j)$ subject to the budget constraint

$$\frac{M(j)}{P} + C(j) = \frac{M_0(j)}{P} + T + D(j) + \frac{W(j)L(j)}{P}, \quad (11)$$

where T denotes per capita real transfers from the Home government, $\frac{W(j)L(j)}{P}$ represents real labor income, $D(j)$ expresses real domestic profits, and $M_0(j)$ are initial nominal money holdings. Foreign individuals face an analogous problem.

The first-order condition for individual j 's nominal money balances, $M(j)$, is given by:

$$\frac{1}{C(j)} = \left(\frac{M(j)}{P} \right)^{-1}. \quad (12)$$

Since money has value only for the current period, individuals equate the marginal utility from holding it to the opportunity cost of acquiring it. Notice that in such a model, money market equilibrium is equivalent to binding cash in advance constraints.⁹

Governments in each country rebate all seignorage revenue in lump-sum transfers to households:

$$T = \frac{M}{P} - \frac{M_0}{P} \quad ; \quad T^* = \frac{M^*}{P^*} - \frac{M_0^*}{P^*}. \quad (13)$$

2.4 Market clearing, exchange rate determination, and terms of trade

The first order conditions are identical for all agents within a given country. Thus, I drop the agent indexation. The product market equilibrium requires that

$$P_H Y_H = \frac{1}{2} PC + \frac{1}{2} EP^* C^* \quad ; \quad P_F Y_F^* = \frac{1}{2} PC + \frac{1}{2} EP^* C^*, \quad (14)$$

which, in turn, implies the following result

$$\frac{P_H}{P_F} = \frac{Y_F^*}{Y_H}. \quad (15)$$

Now, using eq. (13) together with the household's budget constraints (11) leads to

$$PC = P_H Y_H \quad ; \quad EP^* C^* = PC^* = P_F Y_F^*, \quad (16)$$

⁸Note that, given the Cobb-Douglas preferences over traded goods (7) and the separability of individuals' utility functions, international equity trade would not affect equilibrium allocation (see eq. (17)). This implies that current accounts would be zero in an inter-temporal version of the model as well.

⁹In a dynamic version of the model, interest rates would appear in eq. (12); see for instance Obstfeld and Rogoff (1998).

from which

$$C^* = C \quad (17)$$

follows.¹⁰

The exchange rate is simply given by the ratio of national nominal expenditure

$$E = \frac{PC}{P^*C^*}. \quad (18)$$

This result stems directly from the characteristics of current account balance and constant expenditure shares exhibited by the model.

Under a NMP regime, the exchange rate is free to float. Thus, from the money demand (12), I may rewrite the exchange rate as the ratio of money supply in the two countries

$$E = \frac{M}{M^*}. \quad (19)$$

Conversely, in a MU, the exchange rate E is always equal to 1, and the following identities hold:

$$P_F = P_F^* \quad ; \quad P_H^* = P_H \quad ; \quad P = P^* \quad ; \quad M = M^*. \quad (20)$$

Furthermore, the terms of trade are defined in the Home country as

$$TOT \equiv \frac{EP_F^*}{P_H}. \quad (21)$$

A decrease in TOT constitutes a real appreciation of the domestic currency, i.e. an improvement in the Home terms of trade.

The rest of the paper will show how terms-of-trade adjustments play a key role in determining the welfare impact of a monetary regime change. However, before analyzing monetary policy under the two regimes, it is convenient to derive a benchmark policy, i.e. the social planner's problem, and then to assess the macroeconomic interdependencies operating in the model.

3 The efficient allocation and the reduced form

In this section I derive the efficient allocation and the reduced-form of the model. The former is a useful benchmark for the analysis of optimal policy in the presence of monopolistic distortions, while the latter shows macroeconomic interdependence in the two economies.

¹⁰The equality stems from the fact the weights in the consumption index (7) are the same as country size. Were they different, consumption levels would be proportional but not equal.

3.1 Efficient allocation

The efficient allocation is obtained by appointing a central institution (social planner) that maximizes an objective function represented by a weighted average of the welfare of the single countries. Benigno (2002) shows that with an elasticity of intertemporal substitution in consumption equal to one (i.e., log preferences in consumption), the optimal weight of preferences of the social planner coincides with a population-weighted average of welfare of the single countries. Thus, the world's optimal allocation in any given period implies the solution of the following social planner's problem:

$$\max_{C_z, C_z^*, L, L^*, \frac{M}{P}, \frac{M^*}{P^*}} \frac{1}{2} \int_0^1 U(j) dj + \frac{1}{2} \int_0^1 U^*(j^*) dj^* \quad z \in [H, F],$$

subject to the feasibility constraint

$$Y = C_H + C_F \quad ; \quad Y^* = C_H^* + C_F^*$$

and the technological constraint

$$Y = L^\alpha \quad ; \quad Y^* = (L^*)^\alpha.$$

The optimal conditions for the social planner's problem are:

$$\frac{1}{2C_H} = \frac{1}{2C_F} = \frac{k \log L}{\alpha Y}$$

$$\frac{1}{2C_H^*} = \frac{1}{2C_F^*} = \frac{k \log L^*}{\alpha Y^*}$$

$$\left(\frac{M}{P}\right)^{-1} = \left(\frac{M^*}{P^*}\right)^{-1} = 0,$$

i.e. the planner would like to equate the marginal utility of consumption of each tradeable good to the marginal loss of utility of producing an additional unit of the tradeable good. The last condition, instead, requires to equate the (social) marginal utility of real balances to the social marginal cost of producing real money balances, which is zero.

From the resource and technological constraint, it is easy to obtain the following solutions to the social planner's problem:

$$C_H = C_F = C/2 \quad ; \quad C_H^* = C_F^* = C^*/2 \quad (22)$$

$$Y = L^\alpha = C \quad ; \quad Y^* = (L^*)^\alpha = C^* \quad (23)$$

$$\log L = \alpha/k \quad ; \quad \log L^* = \alpha/k. \quad (24)$$

3.2 Reduced form

I now demonstrate a critical insight of the model: the monetary authority's incentive to undertake expansionary policies depends on the international monetary system. In what follows, I will denote natural logarithm of any variable X by the corresponding lower-case letter; thus $x \equiv \log X$. Without loss of generality, I normalize the previous period nominal wage, money supply, and general price level to unity, so that the log of these variables can be considered as an approximation of their percentage increase.

Table 1: Reduced form of the model: NMP regime ($e = m - m^*$)

$l = m - w$	$l^* = m^* - w^*$	(25)
$p_H = (1 - \alpha)m + \alpha w$	$p_F^* = (1 - \alpha)m^* + \alpha w^*$	(26)
$p = \frac{1}{2}[(2 - \alpha)m + \alpha(w + w^* - m^*)]$	$p^* = \frac{1}{2}[(2 - \alpha)m^* + \alpha(w + w^* - m)]$	(27)
$c_H = \alpha(m - w)$	$c_F^* = \alpha(m^* - w^*)$	(28)
$c_F = \alpha(m^* - w^*)$	$c_H^* = \alpha(m - w)$	(29)
$c = \frac{\alpha}{2}(m + m^* - w - w^*)$	$c^* = \frac{\alpha}{2}(m + m^* - w - w^*)$	(30)
$tot = \alpha(m - m^* - w + w^*)$	$e = m - m^*$	(31)

Table 2: Reduced form of the model: MU regime ($e = 0$)

$l = \frac{m^W}{2} - w$	$l^* = \frac{m^W}{2} - w^*$	(32)
$p_H = (1 - \alpha)\frac{m^W}{2} + \alpha w$	$p_F^* = (1 - \alpha)\frac{m^W}{2} + \alpha w^*$	(33)
$p = \frac{1 - \alpha}{2}m^W + \frac{\alpha}{2}(w + w^*)$	$p^* = \frac{1 - \alpha}{2}m^W + \frac{\alpha}{2}(w + w^*)$	(34)
$c_H = \alpha\left(\frac{m^W}{2} - w\right)$	$c_F^* = \alpha\left(\frac{m^W}{2} - w^*\right)$	(35)
$c_F = \alpha\left(\frac{m^W}{2} - w^*\right)$	$c_H^* = \alpha\left(\frac{m^W}{2} - w\right)$	(36)
$c = \frac{\alpha}{2}(m^W - w - w^*)$	$c^* = \frac{\alpha}{2}(m^W - w - w^*)$	(37)
$tot = \alpha(w^* - w)$	$m^* = m = \frac{m^W}{2}$	(38)

The reduced form of the model, apart from constant additive terms, is presented in Table 1 and 2

under NMP and MU respectively.¹¹ Consider a domestic monetary expansion under NMP.

A rise in m leads to an increase in per capita demand, $p + c$, and a proportionate increase in expenditure of the goods that Home agents consume (see eqs. (10) and (12)). For a given level of wages, p_H increases by $1 - \alpha$. It follows that c_H have to rise (eq. (28)). At the same time, the nominal exchange rate depreciates in proportion to money supply (eq. 19); so, $p_F (= e + p_F^*)$ increases by a unit and there is no impact on c_F (eq. 29). c_F is hence determined by the foreign money supply, m^* .¹²

As observed by Canzoneri, Cumby, and Diba (2005), macroeconomic interdependence is rather limited in new open economy macroeconomics models exhibiting balanced current account, constant expenditure shares and log utility of money:

“Domestic monetary policy controls consumption and output of the domestically produced goods, while foreign monetary policy controls consumption of the imported tradeable good”,
p. 371.

In a MU, conversely, the common CB sets the union-wide money growth $m^W = m + m^*$. From eqs. (35) and (36) it appears that not only may the common monetary policy control consumption (and output) of domestically produced goods, but also affects the consumption of the imported tradeable goods. In fact, a rise in $m^W/2$ leads to an increase in aggregate demand, $p + c$, and a proportionate increase in expenditure of Home and Foreign goods. But, with a permanently fixed exchange rate, $p_F = p_F^*$, and producer prices p_H and p_F increase by $1 - \alpha$. It turns out that both c_H and c_F have to rise by α .

It is worth noticing that an expansionary monetary policy under NMP worsens the terms of trade (31), while in a MU the common CB perceives its policy as not affecting the terms of trade (38).

In the following section, I assess optimal monetary policies under the two regimes, and next I turn to the question of how monetary regimes affect wage setting. The model is solved by backward induction.

4 Monetary policy

I draw on Lippi (2003) and assume that the monetary authority aims at maximizing a targeting rule by setting the growth rate of money supply after wages have been negotiated. Under a NMP regime, each monetary authority maximizes the following targeting rule, taking the other’s action as given, i.e. the Home CB solves

$$\max_m \Omega^{NMP} = \int_0^1 \left[U(j) - \log \left(\frac{M(j)}{P} \right) \right] dj - \frac{\beta}{2} p^2 \quad \text{s.t. to (30), (25), (27) and } \partial m^* / \partial m = 0, \quad (39)$$

where the parameter β is the degree of CB conservatism (Rogoff, 1985). If the level of conservatism is zero, the CB is a benevolent planner that cares only about agents’ welfare. Following Obstfeld and Rogoff (1998) and Corsetti and Pesenti (2001), the monetary authority ignores the real balances part of

¹¹The reduced forms of the model are obtained by using eqs. (5), (7)-(10), (14)-(17) and (21).

¹²Note that an increase in m^* has two opposing effect on p_F : increase p_F^* by $(1 - \alpha)$ and depreciate e by unity. Hence, the latter effect is always larger.

the utility function; thus, I abstract from the traditional considerations that lie behind the Friedman rule of zero nominal interest rate.¹³ A symmetric problem is solved by the Foreign CB.

The first-order condition of (39) yields

$$p = \frac{k(\tilde{l} - l) - \alpha/2}{(1 - \alpha/2)\beta}, \quad (40)$$

where $\tilde{l} \equiv \alpha/k$ is the efficient employment level (eq. 24). Since employment l is sub-optimally low owing to monopolistic distortions in labor markets, the monetary authority has an incentive to raise inflation so as to reduce the discrepancy between efficient and natural output. This is the standard Blanchard-Kiyotaki result (captured by the term $\tilde{l} - l$ in eq. (40)), whereby a positive monetary shock unambiguously improves domestic welfare in a closed economy (Blanchard and Kiyotaki, 1987).

Nevertheless, as noted by Corsetti and Pesenti (2001), in an open economy this effect is not sufficient to prevent a deflationary monetary policy.¹⁴ Intuitively, money contraction reduces both consumption and output. But it also improves the terms of trade, thereby increasing consumption and reducing output further. It turns out that the reduction in the disutility of supplying labor services more than offsets the reduction in the utility from lower consumption, because the “burden” of production is shifted to the other country through the improved terms of trade. Such an effect is captured by the negative term on the R.H.S. of eq. (40).

Solving eq. (40) for money supply yields Home policy in terms of Foreign policy, Home wages, and Foreign wages. The Nash equilibrium policies are derived by combining this reaction function with the corresponding one in the Foreign country (see Appendix A).

Now, in order to evaluate how wage setters perceive to affect employment, I plug the Nash equilibrium monetary reaction function into (25) as follows:

$$l = \varepsilon_H^{NMP} w + \varepsilon_F^{NMP} w^*, \quad (41)$$

$$l^* = \varepsilon_{F^*}^{NMP} w^* + \varepsilon_{H^*}^{NMP} w, \quad (42)$$

where

$$\varepsilon_H^{NMP} = \varepsilon_{F^*}^{NMP} < \varepsilon_F^{NMP} = \varepsilon_{H^*}^{NMP} < 0. \quad (43)$$

In a MU regime the CB aims at solving the following problem

$$\max_{m^w} \Omega^{MU} = \frac{1}{2} \int_0^1 \left[U(j) - \log \left(\frac{M(j)}{P} \right) \right] dj + \frac{1}{2} \int_0^1 \left[U(j^*) - \log \left(\frac{M(j^*)}{P^*} \right) \right] dj^* - \frac{\beta}{2} p^2 \quad (44)$$

s. to (37), (32), and (34),

¹³Neiss (1999) for example assesses the validity of the Friedman rule and the welfare effect of real money balances in the presence of predetermined wage setting; an extension of her model to the case of non-atomistic wage setters is in Acocella, Di Bartolomeo, and Tirelli (2008).

¹⁴For an empirical evidence that relatively open countries experience lower inflation see Romer (1993), Lane (1997), and Campillo and Miron (1997).

by controlling the growth rate of union-wide money supply m^W . The first-order condition of (44) is given by

$$p = \frac{k}{\beta(1-\alpha)/2}(\tilde{l} - l), \quad (45)$$

where I used the equality condition between Home and Foreign employment in the MU regime.¹⁵ The common CB equates marginal benefits of raising union-wide employment (R.H.S. of eq. (45)) to marginal costs of its inflationary policy (L.H.S. of eq. (45)). The following proposition summarizes the result of a change in the monetary regime.

Proposition 1 *A switch from NMP to a MU entails a more inflationary monetary policy.*

The proof is straightforward.

Comparing eqs. (45) and (40), it appears that eq. (45) is always above eq. (40) in the (l, p) space. More specifically, moving to a MU induces an upwards shift *and* a clockwise rotation of the domestic monetary reaction function. The first effect is due to the disappearance of the terms-of-trade externality. Maximizing the union-wide utility, the common CB in fact internalizes the impossibility of improving the terms of trade in both countries (see eq. (38)). The second effect is instead due to the disappearance of exchange rate movements in the MU regime. Under NMP, an expansionary monetary policy leads to a rise in domestically produced traded good and a depreciation of the exchange rate. Both effects raises inflation. In a MU, instead, the inflationary cost stemming from exchange rate movements are ruled out and, *ceteris paribus*, the common CB faces lower marginal costs from an expansionary policy.

Before the formation of the EMU, monetary policy in Germany hinged on interactions between German labor unions and the monetary policy of the Bundesbank. According to Proposition 1, did the ECB obtain autonomy and conservatism equal to the Bundesbank, the ECB monetary-policy stance on the German economy would have been more expansionary relative to the Bundesbank, thereby triggering higher inflation. In this respect, Proposition 1 also provides a rationale for having appointed a more conservative ECB (Piga, 2000).

Before turning to the subgame-perfect solution, I write the corresponding values of employment substituting the money supply solutions of problem (44) into eq. (32) as follows (see Appendix B for the elasticities values):

$$l = \varepsilon_H^{MU} w = \varepsilon_F^{MU} w^*, \quad (46)$$

$$l^* = \varepsilon_{F^*}^{MU} w^* = \varepsilon_{H^*}^{MU} w, \quad (47)$$

where

$$\varepsilon_H^{MU} = \varepsilon_{H^*}^{MU} = \varepsilon_F^{MU} = \varepsilon_{F^*}^{MU} < 0. \quad (48)$$

¹⁵From Table 2, in fact, I obtain in a MU regime that $p + c = w + l = p^* + c^* = w^* + l^*$, which can be solved by setting $w = w^*$ and $l = l^*$.

5 Wage setting

Home workers are organized in $n > 1$ labor unions. I assume that all labor types are unionized and equally distributed among unions. Therefore, each union u has mass $1/n (= \int_{j \in u} dj)$. In such a setup, both the degree of wage centralization and the unions' ability to internalize the consequences of their actions are proportional to the union's size: the smaller the number of unions, the more they internalize the impact of their wage settlement on aggregate wage. In fact, controlling the growth of the nominal wage w_u , each union u anticipates that

$$\frac{\partial w}{\partial w_u} = \frac{1}{n} \left(\frac{w_u}{w} \right)^{-\sigma} \quad (49)$$

taking other unions' wages both at Home and abroad as given.

Eq. (49) is key to understand the model results. As long as n is finite, an increase in the union's wage affects aggregate wage which, in turn, reduces aggregate employment by eqs. (41)-(42) or (46)-(47). In addition, a rise in w_u reduces also employment through the elasticity of substitution among labor types σ , since firms substitute the u -th labor variety for the other labor types. In a symmetric equilibrium ($w_u = w$), the elasticities of Home labor demand to nominal wage of union u ($\partial l_u / \partial w_u$) under NMP and MU are respectively

$$\varepsilon_h^{NMP} = -\sigma \left(1 - \frac{1}{n} \right) + \frac{1}{n} \varepsilon_H^{NMP} \quad ; \quad \varepsilon_h^{MU} = -\sigma \left(1 - \frac{1}{n} \right) + \frac{1}{n} \varepsilon_H^{MU}. \quad (50)$$

Eq. (50) defines the elasticity of domestic labor demand perceived by the u -th union as a weighted average of the elasticity of substitution between labor types and the elasticity of domestic aggregate labor demand. It turns out that, with atomistic wage setters ($n \rightarrow \infty$), eq. (50) is simply formed by the elasticity of substitution, and unions do not take into account the impact of their wage claims on aggregate employment. The weight of the elasticity of aggregate labor demand in eq. (50) is instead increasing in the union's size (lower n). With a single all-encompassing union ($n = 1$) each labor-type service receives the same wage, thereby preventing any substitution effect between labor types from operating.

The domestic monetary response to domestic wages has been recently investigated in the literature (e.g. Lippi, 2002, 2003; Cavallari, 2004; Coricelli, Cukierman, and Dalmazzo, 2004; Gnocchi, 2006), while the *foreign* monetary response to domestic wages has been ignored by these studies. However, since in an open economy both Home and Foreign monetary policies are common knowledge for the u -th union, a large union internalizes the impact of its wage demands on Foreign labor markets as well. Thus, from eqs. (42) and (47), a change in w_u affect Foreign employment as follows:

$$\varepsilon_{h^*}^{NMP} = \frac{1}{n} \varepsilon_{H^*}^{NMP} \quad ; \quad \varepsilon_{h^*}^{MU} = \frac{1}{n} \varepsilon_{H^*}^{MU}. \quad (51)$$

Intuitively, an increase in the Home nominal wage w leads to higher inflation in the Foreign country because of the rise in p_H . As a result, for a given exchange rate, the corresponding (optimal) Foreign monetary policy balances the burden of the welfare loss between employment and inflation by moving

employment and inflation into the opposite direction (see eqs. (40) and (45)) so that Foreign employment falls in the wake of Home wage claims.

I assume that the representative Home union u acts benevolently by maximizing the utility of its members (of mass $1/n$) and disregarding liquidity effects. Therefore, it solves the following problem in either regime:¹⁶

$$\max_{w_u} V_u = n \int_{j \in u} \left[U(j) - \log \left(\frac{M(j)}{P} \right) \right] dj \quad \text{s. to (11), (1), (50), (51),} \quad (52)$$

$$\partial w_{u^*} / \partial w_u = 0, \text{ and } \partial w_{j \notin u} / \partial w_u = 0.$$

Equilibrium employment under the two monetary regimes is derived from the first-order condition of (52) evaluated at the symmetric equilibrium $w_u = w$ (see Appendix C) as follows:

$$l^r = \tilde{l} \left(1 - \frac{1}{\eta^r} \right), \quad r \in (NMP, MU) \quad (53)$$

where $\eta^r \equiv -d \log L_u^r / d \log (W_u / P^r) > 1$ is the real consumption wage elasticity (in absolute value) of the perceived demand for labor type $j \in u$ in regime r . It is apparent that, as long as η is finite, equilibrium employment is below the efficient level \tilde{l} in either regime. More specifically, a lower labor demand elasticity implies that, for a given level of employment, nominal wage hikes yield higher marginal benefits in terms of consumption, thereby reducing wage restraints. In other words, η is a measure of the monopolistic power of unions. Rewriting eq. (53)

$$\frac{1}{\eta^r} = \frac{1 - s_h^r}{\varepsilon_h^r} = \frac{\tilde{l} - l^r}{\tilde{l}}, \quad r \in (NMP, MU) \quad (54)$$

where $s_h^r \equiv \partial \log P^r / \partial \log W(u)$ is the elasticity of CPI to nominal wage u , the elasticity of labor demand to *real* wages measures the percentage deviation of natural employment from efficient employment. The lower η , the higher is the perceived real wage obtained by unions in the wake of *nominal* wage claims.

To understand expression (54), note that the term $s_h \in (0, 1)$ in the numerator reduces the monopolistic distortion in the labor market. An increase in the wage u raises the general price level, which in turn reduces the real wages of union members. Similarly, an increase in labor demand elasticity to nominal wage ε_h implies that, for a given increase in w_u , the reduction in employment and hence in labor income is more considerable. It turns out that an increase in ε_h and s_h leads to lower wage demands.

Now, from eqs. (40), (45) and (53) the equilibrium rate of inflation in either regime is given by:

$$p^{NMP} = \frac{\alpha(1/\eta^{NMP} - 1/2)}{\beta(1 - \alpha/2)}, \quad (55)$$

¹⁶The benevolent union hypothesis is in line with the trade union behavior surveyed by Oswald (1985), whose objective function usually includes real wages and unemployment.

$$p^{MU} = \frac{\alpha/\eta^{MU}}{\beta(1-\alpha)/2}. \quad (56)$$

The key implication of these two expressions is that in a MU, eq. (56) features an *inflation bias* while, a NMP regime may trigger a *deflation bias* (eq. (55)). It follows that, for a given degree of CB conservatism, equilibrium inflation is lower under a NMP regime than in a MU. Intuitively, under a floating exchange rate, monetary authorities are induced to resort to surprise monetary contractions because they perceive to affect the terms of trade. Conversely, the MU economy as a whole is not affected by the terms of trade externality and exchange rate movements, thereby leading the common CB to a more expansionary monetary policy (see Section 4).

The next sections will show how different institutions, in particular centralized wage setting, CB conservatism, and monetary regime, cause workers to modify their wage claims.

6 The effect of the monetary regime

This section assesses the role of moving from NMP to a MU regime *per se*.

In order to disentangle the strategic mechanisms operating in η^r , it is convenient to rewrite the elasticities of labor demand to real wages under the two monetary regimes as follows:

$$\eta^{NMP} = \left[\underbrace{\left(1 - \frac{\varepsilon_H^{NMP}}{n\varepsilon_h^{NMP}}\right) \frac{1}{\sigma}}_{\text{substitution effect}} + \underbrace{(1-\alpha) \frac{\varepsilon_H^{NMP}}{n\varepsilon_h^{NMP}}}_{\text{output effect}} + \underbrace{\left(\frac{\alpha}{2} \frac{\varepsilon_H^{NMP} - \varepsilon_{H^*}^{NMP}}{\varepsilon_H^{NMP}}\right) \frac{\varepsilon_H^{NMP}}{n\varepsilon_h^{NMP}}}_{\text{terms-of-trade effect}} \right]^{-1} \quad (57)$$

$$\eta^{MU} = \left[\underbrace{\left(1 - \frac{\varepsilon_H^{MU}}{n\varepsilon_h^{MU}}\right) \frac{1}{\sigma}}_{\text{substitution effect}} + \underbrace{(1-\alpha) \frac{\varepsilon_H^{MU}}{n\varepsilon_h^{MU}}}_{\text{output effect}} \right]^{-1}. \quad (58)$$

The incentive to set a higher nominal wage w_u depends on three effects.

First, since other unions' policy is taken as given, the u -th union perceives to increase its wage relative to the other unions' wage. More specifically, for a unit increase in the u -th union's wage, the increase in its wage relative to the other unions' wages is higher, the lower the impact on aggregate wage. However, the aggregate wage adjusts according to the aggregate labor elasticity which, in turn, is increasing in the tightness of monetary policy responses toward wages. Thus, the more accommodating the monetary policy, the more aggressive wage demands are, since wage setters perceive the possibility of achieving higher wage deviations from the other unions' wages. This effect is captured by the first term in eqs. (57) and (58), and, drawing on Lippi's (2003) terminology, is labeled "substitution effect".

Note that, as long as the direct effect of w_u on w ($1/n$) is less than one, the union has an incentive to exploit its monopolistic power on the labor services market. In the extreme case of a single all-encompassing union ($n = 1$), ε_h^r is equal to ε_H^r , and the substitution effect disappears. A wage rise, in this

case, leads to an equal proportional increase in aggregate wage without any possibility for the union of increasing its relative wage.

Second, the u -th union anticipates that its real production wage (i.e., $w_u - p_H$) increases in the wake of a nominal wage rise through the reduction in aggregate output. This effect is captured by the second term in eqs. (57) and (58), and, drawing on Lippi's (2003) terminology, is labeled "output effect". Specifically, from eq. (5), a nominal wage rise is perceived to increase the real production wage by the elasticity of aggregate employment to real production wage $(1 - \alpha)^{-1}$.

In a closed economy, the producer price index coincides with the consumer price index. Therefore, in Lippi (2003) the output and substitution effects are the sole effects taken into account by unions in their wage setting process. In this model, eqs. (57) and (58) reveals that both η^{MU} and η^{NMP} are constituted by the output and substitution effect. But η^{NMP} is further reduced by a third effect: the improvement in the terms of trade.¹⁷

Proposition 2 *When monetary policy is performed*

- i. *under a NMP regime, a domestic union expects an improvement in the terms of trade as a result of a nominal wage rise.*
- ii. *in a MU, a domestic union does not perceive that it can affect the terms of trade.*

In order to prove this proposition, it is helpful to investigate how w_u affects the terms of trade. From eqs. (31) and (38), it turns out that

$$\frac{\partial \text{tot}^{NMP}}{\partial w_u} = \frac{\alpha}{n} (\varepsilon_H^{NMP} - \varepsilon_{H^*}^{NMP}) < 0, \quad \frac{\partial \text{tot}^{MU}}{\partial w_u} = \frac{\alpha}{n} (\varepsilon_H^{MU} - \varepsilon_{H^*}^{MU}) = 0. \quad (59)$$

Each Home union anticipates that a wage rise may change the terms of trade through the difference between the elasticity of (aggregate) domestic and foreign employment. I label that mechanism the "terms-of-trade effect". Such an effect is present only under a NMP regime (see eq. (57)) because the Home employment elasticity to Home wage (ε_H^{NMP}) is (in absolute value) larger than the Foreign employment elasticity to Home wage ($\varepsilon_{H^*}^{NMP}$). In such a case, a Home wage hike entails an improvement in the Home terms of trade which, in turn, reduces the consumer price index. As a result, the real consumption wage ($w_u - p$) rises because of the terms of trade appreciation, encouraging nominal wage demands.¹⁸

Conversely, in a MU, both Home and Foreign labor demand elasticities to Home wages are equal (see eq. (48)), and the terms-of-trade effect is prevented from operating. A common CB in fact internalizes the terms-of-trade externality and, maximizing the union-wide utility, reacts symmetrically to inflationary

¹⁷Among the first to highlight such effect, in a first generation of game-theoretic models *à la* Canzoneri and Henderson (1988), is Jensen (1993) who shows that the real exchange rate appreciation drives a wedge between the consumption and production real wage, thereby inducing unions to be more aggressive in their wage requests.

¹⁸Cavallari (2004) omits such a wedge between the real consumption wage elasticity and the real production wage elasticity of perceived labor demand under either regime. Thus, her results hinge only on the output and substitution effects.

wage claims in the two countries. Intuitively, since Home and Foreign inflation are equal in a MU (see Table 2), a domestic nominal wage increase has the same effect on inflation at Home and abroad ($p = p^*$), thereby triggering a symmetric monetary reaction. Moreover, as noted in footnote 15, in a MU labor unions anticipate that both employment and wages are equalized between countries because of the full risk-sharing condition. Therefore, the real consumption wage elasticity of the perceived labor demand equates to the real production wage elasticity (58) as in a closed-economy framework.

What is then the direct effect of a MU on the labor demand elasticity η ? To answer this question, I first assume that wage setting is highly centralized, i.e. $n = 1$. In such a case, the wage bargaining system is fully centralized,¹⁹ and the substitution effect is absent in η . It turns out that

Proposition 3 *When labor markets are characterized by nationally defined systems of collective bargaining, a move from a NMP regime to a MU is always welfare improving.*

The proof is straightforward.

Comparing eqs. (57) and (58), and noticing that the labor type demand elasticity (ε_h) coincides with the aggregate labor demand elasticity to wage (ε_H) when $n = 1$, the following relation holds:

$$\eta^{NMP}|_{n=1} = \left[1 - \alpha + \frac{\alpha}{2} \left(\frac{\varepsilon_H^{NMP} - \varepsilon_H^{NMP*}}{\varepsilon_H^{NMP}} \right) \right]^{-1}, \quad \eta^{MU}|_{n=1} = [1 - \alpha]^{-1}, \quad (60)$$

where $\frac{\varepsilon_H^{NMP} - \varepsilon_H^{NMP*}}{\varepsilon_H^{NMP}} > 0$. Moreover, since the equilibrium level of employment (53) is equal in the two countries, welfare can be rewritten in equilibrium as:

$$u = \alpha l - \frac{k}{2} l^2 = u^*,$$

which is clearing increasing in l as long as employment is below its efficient level \tilde{l} .

Before analyzing the more general case of $n > 1$, it would be interesting to assess the “relative size” of all effects entering in η . The α parameter in the model measures the aggregate labor share, whose values are usually in the interval 0.55 – 0.65 (e.g. Kongsamut, Rebelo, and Xie, 2001). This implies $\eta^{NMP}|_{n=1} \in (1.38, 1.93)$ and $\eta^{MU}|_{n=1} \in (2.22, 2.86)$. Now, microeconomic evidence and calibrated models suggest values for the elasticity of substitution not smaller than 2.5 and not greater than 21 (e.g. Griffin, 1992; Christiano, Eichenbaum, and Evans, 2005). In accordance with this, the following proposition holds.

Proposition 4 *For any $\sigma \geq \eta^{NMP}|_{n=1}$ and $n > 1$,*

$$\eta^{MU} > \eta^{NMP},$$

i.e. the move from NMP to MU increases both employment and welfare.

¹⁹Wage determination in most OECD countries is dominated by nationally defined systems of collective bargaining (e.g. Nickell, Nunziata, and Ochel, 2005).

The formation of a MU may have two contrasting effects on real labor demand elasticity. First, the disappearance of exchange rate movements and the impossibility of strategically improving the terms of trade induce the CB to a more accommodating monetary policy (see Section 4). This in part reduces the labor demand elasticity to a real production wage perceived by unions, and increases wage aggressiveness relative to NMP.²⁰ Secondly, the incentive to a strategic use of the terms of trade (i.e., the terms-of-trade effect) causes unions to demand a higher wage under NMP relative to a MU regime. From Proposition 4, it turns out that the incentive to set higher wages is nevertheless discouraged in a MU since the terms-of-trade channel prevails over the aggregate output channel.

It is worth noticing that such the results in this section are in sharp contrast with most of the predictions about the effects of a switch from NMP to the MU regime which do not consider the role of terms-of-trade effect (e.g. Cukierman and Lippi, 2001; Soskice and Iversen, 1998; Cavallari, 2004). In addition, Proposition 4 can account for the wage-growth trend in Europe, which has remained under control since the formation of EMU (European Commission, 2007).

7 The effect of centralization in wage setting and CB conservatism

This section assesses the real effects of the wage-bargaining system and CB conservatism.

To this purpose, it is convenient to rewrite the real wage elasticity $1/\eta^r$ as follows:

$$\frac{1}{\eta^r} = \frac{1}{\sigma} \left(1 - \frac{\varepsilon_H^r}{n\varepsilon_h^r} \right) + \frac{1}{\eta^r|_{n=1}} \frac{\varepsilon_H^r}{n\varepsilon_h^r}, \quad (61)$$

which is a weighted average measuring the monopolistic distortion in the labor market, whereby the higher $1/\eta^r$, the more monopolistic power unions have.

Note that the “weight” entering in the labor demand elasticity η^r is given by

$$\frac{\varepsilon_H^r}{n\varepsilon_h^r} = \frac{1}{1 + \frac{\sigma(n-1)}{\varepsilon_H^r}}. \quad (62)$$

From the above expression is hence apparent that n and ε_H^r have two opposing effect on the weight attached to the elasticity of labor demand to real wage. More specifically, an increase in the number of unions reduces eq. (62), while an increase in aggregate labor demand elasticity raises it.

7.1 Collective bargaining coverage

How does the collective bargaining coverage system affect welfare?

Proposition 5 *An increase in the number of unions, i.e. a more decentralized wage setting, raises (reduces) welfare and reduces (raises) inflation under the regime $r \in (NMP, MU)$ if $\sigma > \eta^r|_{n=1}$ ($\sigma < \eta^r|_{n=1}$).*

²⁰It is possible to show that ε_H^{NMP} is greater than ε_H^{MU} only for a range of value of the degree of CB conservatism given by: $0 < \beta < \bar{\beta}$. Conversely, for a sufficiently high degree of conservatism $\beta > \bar{\beta} > 0$, the aggregate employment elasticity to nominal wage is higher in a MU.

The intuition for this ambiguous result stems from eq. (61). Since $1/\eta^r$ is a linear combination of $1/\sigma$ and $1/\eta^r|_{n=1}$, an increase in n puts more weight on the substitution effect operating in the labor demand elasticity, so that employment increases and inflation diminishes only if $\sigma > \eta^r|_{n=1}$ (see eqs. (53), (40), (45), and (61)). Opposite effects occur if $\sigma < \eta^r|_{n=1}$.²¹ Furthermore, since employment is inefficiently low, an increase in labor demand elasticity is accompanied by an increase in welfare as well. It follows that, an improvement in economic performance and welfare hinges on complementarity between labor market distortions and centralization of wage setting. More specifically, labor markets featuring sizeable (low) monopolistic distortions has to be associated with centralized (decentralized) wage bargaining.

This result differs from Coricelli, Cukierman, and Dalmazzo (2004). They find that a larger number of unions in a MU always worsens economic performance at Home. The explanation of such a different prediction is due to the absence of a substitution effect in their model. As labor services are not substitutable in production, the output effect is always larger than the substitution effect which, in turn, implies that economic performance is unambiguously decreasing in the decentralization of wage bargaining.

It is worth noticing that the condition in Proposition 5 referring to a MU exactly reproduces Lippi's (2003) finding. This coincidence is due to the fact that unions perceive their wages as not having any impact on the terms of trade (see eq. (59)). In other words, the strategic interactions operating in η^{MU} are isomorphic to the closed-economy ones. By contrast, under NMP, Home and Foreign monetary authorities do not internalize the impact of their policies on the other country and causes their desired response toward a domestic wage increase to be asymmetrical. Thus, not only substitution and output effect matter, but also the terms of trade effect accounts for unions' wage demands under NMP.

7.2 CB conservatism

How does the degree of CB conservatism affect welfare?

Proposition 6 *As long as $n \in (1, \infty)$, an increase in CB conservatism raises (reduces) welfare under the regime $r \in (NMP, MU)$ if $\sigma < \eta^r|_{n=1}$ ($\sigma > \eta^r|_{n=1}$).*

A higher degree of CB inflation aversion implies that monetary policy accommodates wage hikes to a lesser extent, thus leading to higher (in absolute value) aggregate labor demand elasticities (ϵ_H^r). This has two opposing effect on η .

As noted above, the monopolistic distortion in the labor market is simply a weighted average of the strategic effects $1/\sigma$ and $1/\eta^r|_{n=1}$, where the weights are given respectively by $\left(1 - \frac{\epsilon_H^{NMP}}{n\epsilon_h^{NMP}}\right)$ and $\left(\frac{\epsilon_H^{NMP}}{n\epsilon_h^{NMP}}\right)$.

Now, an increase in β causes a rise in ϵ_H^r , thereby increasing the weight attached to the $1/\eta^r|_{n=1}$ component (see eq. (62)). As a result, if $\sigma < \eta^r|_{n=1}$, a more conservative CB is beneficial in terms of

²¹Notice that, for given values of σ and $\eta^r|_{n=1}$, Proposition 5 entails a monotonic relation between the degree of centralization in wage setting and economic performance. This is in contrast with the U-shape curve *à la* Calmfors and Driffill (1988). The main reason for the absence of a Calmfors-Driffill curve in models with constant elasticity of substitution between labor types is provided by Guzzo and Velasco (1999).

welfare because it reduces labor market distortions. Conversely, if $(\sigma > \eta^r|_{n=1})$, the society would be better off by appointing a less conservative CB. Such a complementarity between labor market distortions and the degree of conservatism may then explain the appointment of a more conservative CB on the grounds of monopolistic distortions in European labor markets.

The ambiguous result in Proposition 6 is in contrast with Coricelli, Cukierman, and Dalmazzo (2004) where a more conservative CB always boosts employment in a MU. As previously highlighted, their result hinges on the fact that the production function does not exhibit any substitution effect. In other words, their prediction is replicated in this model when the substitution effect is relatively low, so that conservatism has an increasing effect on employment in a MU.

Finally, as noted in the previous section, Proposition 6 extends the Lippi's (2003) findings in two respects. First, the strategic effects operating in an open economy under NMP and flexible exchange rate include not only the substitution and output effects, but also the terms-of-trade effect. Second, a MU regime replicates his results because of the absence of a terms-of-trade effect.

8 Conclusions

I have considered the impact of a switch from a floating exchange rate regime to a monetary union (MU) in a monetary policy game based on a simple microfounded general equilibrium model. The analysis has shown that the impact of wage demands on the terms of trade is perceived by unions as being substantially different under national monetary policies (NMP) and in a MU. In particular, under NMP the asymmetric responses of domestic and foreign monetary policies to domestic wage hikes lead unions to anticipate an improvement in the terms of trade, thereby reducing wage restraints. Intuitively, for a given labor demand elasticity, the improvement in the terms of trade in the wake of a nominal wage increase let unions achieve a higher real consumption wage. Conversely, in a MU each union anticipates its wage demands not affecting the terms-of-trade because of the symmetric monetary wage responses in both countries. The lack of such a terms-of-trade effect in a MU induces to larger wage restraints, thereby raising both employment and welfare.²²

Moreover, the paper highlights how the two monetary regimes modify the impact of a centralized system of wage bargaining and central bank (CB) conservatism on welfare. In general, in order to improve economic performance, a higher (lower) degree of conservatism and centralized wage setting are to be associated with sizeable (lower) distortions in the labor markets. More specifically, the sign of the effect of CB conservatism and of a centralized system of wage bargaining on employment and welfare depends instead on the unions' incentive to move the terms of trade under NMP. In this respect the Lippi's (2003) result, whereby conservatism of monetary policy and centralized wage setting affect equilibrium employment only through the output and substitution effect, is modified under NMP so as to allow for the terms-of-trade effect. Conversely, his results are replicated in a MU.

²²This result is in line with the nominal wage moderation experienced in Europe since the formation of the EMU (European Commission, 2007).

Appendixes

A Derivation of monetary policies under a NMP regime

Solving (39) and the corresponding Foreign CB problem explicitly for money supplies yields, apart from constant additive terms, the following CB reaction functions:

$$m = \frac{k - \beta(1 - \theta)\theta}{k + \beta\theta^2}w + \frac{\beta(1 - \theta)\theta}{k + \beta\theta^2}[m^* - w^*],$$

$$m^* = \frac{k - \beta(1 - \theta)\theta}{k + \beta\theta^2}w^* + \frac{\beta(1 - \theta)\theta}{k + \beta\theta^2}[m - w],$$

where $\theta \equiv 1 - \alpha/2 \in (1/2, 1)$. The Nash equilibrium is hence obtained in the point where these curves intersect:

$$m = \frac{k^2 - \beta^2(1 - \theta)\theta^2 + k\beta\theta(1 - \alpha)}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}w - \frac{\beta^2(1 - \theta)\theta^2}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}w^*,$$

$$m^* = \frac{k^2 - \beta^2(1 - \theta)\theta^2 + k\beta\theta(1 - \alpha)}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}w^* - \frac{\beta^2(1 - \theta)\theta^2}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}w.$$

In order to find the aggregate employment elasticities, I plug the Nash solution of money supplies into (25) as follows:

$$l = -\underbrace{\frac{\beta\theta(k + \beta\theta^2)}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}}_{\varepsilon_H^{NMP}}w - \underbrace{\frac{\beta^2(1 - \theta)\theta^2}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}}_{\varepsilon_F^{NMP}}w^*,$$

$$l^* = -\underbrace{\frac{\beta\theta(k + \beta\theta^2)}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}}_{\varepsilon_{F^*}^{NMP}}w^* - \underbrace{\frac{\beta^2(1 - \theta)\theta^2}{(k + \beta\theta)[k + \beta\theta(1 - \alpha)]}}_{\varepsilon_{H^*}^{NMP}}w.$$

B Derivation of monetary policies under a MU regime

Solving (44) yields, apart from constant additive terms, the following CB reaction function:

$$m^W = \frac{(w + w^*)(k - (1 - \alpha)\alpha\beta)}{k + (1 - \alpha)^2\beta}.$$

Thus, using the relations obtained in footnote 15, aggregate employment elasticities are found by plugging the above solution into (32) as follows:

$$l = -\underbrace{\frac{\beta(1 - \alpha)}{k + \beta(1 - \alpha)^2}}_{\varepsilon_H^{MU}}w = -\underbrace{\frac{\beta(1 - \alpha)}{k + \beta(1 - \alpha)^2}}_{\varepsilon_F^{MU}}w^*,$$

$$l^* = \underbrace{-\frac{\beta(1-\alpha)}{k+\beta(1-\alpha)^2}}_{\varepsilon_{F^*}^{MU}} w^* = \underbrace{-\frac{\beta(1-\alpha)}{k+\beta(1-\alpha)^2}}_{\varepsilon_{H^*}^{MU}} w.$$

C Derivation of union's first-order condition

The u -th union first-order condition is obtained by solving (52)

$$-nk \int_{j \in u} \log L(j) \frac{\partial \log L(j)}{\partial \log W(j)} dj + \frac{W(j)L(j)}{PC(j)} \left[1 + \frac{\partial L(j)}{\partial W(j)} \frac{\partial W(j)}{\partial \log W(j)} \frac{1}{L(j)} - \frac{\partial P}{\partial W(j)} \frac{\partial W(j)}{\partial \log W(j)} \frac{1}{P} \right] = 0. \quad (63)$$

From firms profit maximization, it turns out that in a symmetric equilibrium $WL/(PC) = \alpha$. Thus, I may write (63) as follows:

$$\alpha(1 + \varepsilon_h - s_h) = k \log L \varepsilon_h, \quad (64)$$

where $s_h \equiv \partial \log P / \partial \log W(j)$. Using the definition of η into (64) yields eq. (53) in the text.

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