

Foreign Central Bank Conservativeness and Unionized Wage Setting

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Abstract

The design features of central banks have international significance due to their impact on other countries. Domestically, a more conservative central bank generates a tighter policy, which reduces inflation fears, but meanwhile, it increases unemployment fears for labor unions (due to the trade-off along the Phillips curve). Therefore, domestic conservativeness has an ambiguous effect on real wage claims. This paper shows that a foreign central bank's conservativeness differs in impact, as it reduces both types of fears, and hence, it always deters real wage claims. Therefore, the home country has a clear interest in the design of an ultra-conservative or strictly inflation targeting foreign central bank.

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1 Introduction

The effect of monetary policy on collective wage setting is the subject of a growing literature. Among others, Soskice and Iversen (2000) have shown that the conduct of monetary policy affects the real economy even in the long-run, which contrasts with the conventional view that monetary policy is neutral in the long-run. This observation has generated a debate about which type of central bank is better for society in the presence of labor unions.¹ While this literature has focused on the design of the domestic central bank, it has neglected the impact of the institutional design of the *foreign* central bank.

However, the impact of the foreign monetary institution on the home economy is of practical importance: Often, the change of a chairman, which may influence the central bank's conservativeness, is followed with great interest internationally. The expansion of the Euro-zone has been replacing one-by-one the monetary regimes with the higher conservativeness of the ECB, thus affecting the interactions with non-member states. Schnabl and Ziegler (2011) lend empirical support to the idea that nominal exchange rate movements, which are a function of two countries' policies, influence the wage growth of labor unions. Hence, the question is, how does foreign monetary policy, which interacts also with home monetary policy, affect wage claims in the home country, and what is its impact on the home economy? This issue has not been inves-

¹The literature identifies two opposite effects of domestic conservativeness on real wage claims. On the one hand, Soskice and Iversen (1998, 2000), Bratsiotis and Martin (1999), Coricelli, Cukierman and Dalmazzo (2004) find that higher conservativeness induces lower real wage claims, based on the assumption that labor unions are not inflation averse. On the other hand, Skott (1997), Cukierman and Lippi (1999), Guzzo and Velasco (2002), and Lawler (2000) and Lippi (2002) find that conservativeness induces higher real wage claims, given that there is a monopoly labor union which is also inflation averse. Coricelli, Cukierman and Dalmazzo (2006) propose a unifying framework that embeds the different mechanisms and show that an intermediate degree of conservativeness may be optimal for society. One difference between these type of models and Rogoff's (1985b) seminal work on conservativeness is the presence of labor unions, which creates a non-zero impact on long-run unemployment.

tigated before. This paper reveals that the impact of foreign conservativeness differs from that of domestic conservativeness: unlike domestic conservativeness, a higher degree of foreign conservativeness is always beneficial for the home economy.

In order to study the cross-country effects of conservativeness, we introduce two countries with open economies linked with a flexible exchange rate. The foreign country is not necessarily unionized, but the home country has an arbitrary number of labor unions. The unionized setting is relevant for countries across Continental Europe, including Scandinavia, but excluding Switzerland, where collective wage bargaining coverage is high. Crucially, the presence of labor unions allows to obtain a non-neutral impact of monetary policy in the long-run. Thus, even relatively weak interactions may be significant, because they affect economic performance and growth in the long-run.

A well-known result from open economy models, such as the Mundell-Fleming type models or the Obstfeld and Rogoff (1995) model, is that a foreign monetary contraction may either reduce the home country's unemployment, which is called a beggar-thy-neighbor effect, or it may increase home unemployment, which is called a locomotive effect. Thus, it appears that foreign conservativeness may either increase or reduce the threat of unemployment for home labor unions. However, this paper shows that even if the effect is beggar-thy-neighbor, the optimal reaction of the home central bank overturns it into a locomotive effect. The reason is that foreign tightening creates a negative externality for the home country. The home central bank's optimal policy balances the burden between unemployment and inflation, and as a result, unemployment rises as inflation rises. Therefore, both countries' unemployment rates move in the same direction.

The main result of this paper is that foreign conservativeness improves the economic performance of the home country. This is based on the following mechanism. When a labor union sets the nominal wage, it fears the rise in the price level, mainly because

that reduces its real wage and it also fears the rise in the unemployment rate. Both of these fears are amplified by the foreign central bank and they act as a deterrent against home wage claims: An increase in home wages increases the foreign consumer price level due to imported inflation, and it reduces foreign unemployment due to gains in international competitiveness. The foreign central bank reacts unequivocally by tightening its policy. Moreover, the higher the degree of foreign conservativeness, the stronger is the tightening of foreign policy. As described above, the foreign tightening coupled with the optimal home policy reaction, generate higher home unemployment and inflation. Therefore, the home labor union experiences higher inflation and unemployment threats, both of which deter its wage claims. The consequence of moderate wage claims is lower unemployment and inflation in equilibrium. Thus, the more conservative the foreign central bank, the lower is home unemployment and inflation.

The structure of the paper is as follows. Section 2 presents a two-country model with optimal monetary policies and labor unions. Section 3 discusses the effects of foreign conservativeness. Section 4 draws the conclusions. The Appendix presents some of the derivations and the proofs.

2 The model

There are two countries that are open to trade and capital flows. The interactions among labor unions, central banks and firms evolve in a three stage game as follows: (1) labor unions set nominal wages into binding labor contracts; (2) the central banks of the two countries set the money supplies; (3) firms set prices. The game is solved with the backward induction procedure. This timing of the game is justified by the fact that as long as wages are fixed, firms will not adjust their prices fully. Hence, monetary policy has real effects in the short run, represented by the last stage, where

wages are fixed. In the first stage, where labor unions adjust wages, the long-run equilibrium is obtained. This timing of the game is also used in Coricelli, Cukierman, and Dalmazzo (2006).

2.1 Demand and supply

Aggregate demand in the home and the foreign country is

$$y = -\eta(p - \bar{p}) + \bar{y}, \quad (1)$$

$$y^* = -\eta(p^* - \bar{p}^*) + \bar{y}, \quad (2)$$

where a star denotes foreign country variables, $\eta > 1$ is the elasticity of demand, p is the price of a domestically produced basket of goods, \bar{p} is the consumer price index and $\bar{y} = sy + (1 - s)y^*$ is world income, where $s \in (0, 1)$ is the relative size of a country. The budget of a consumer is proportional to the real money balances that it holds, consistently with standard representations such as Blanchard and Kiyotaki (1987), that is, in the case of a home consumer $m - \bar{p}$ and in the case of a foreign consumer $m^* - \bar{p}^*$, where m and m^* are the nominal money balances of the two countries. The total amount of goods that can be purchased worldwide is determined by the aggregate budget of the home consumers and the foreign consumers,

$$\bar{y} = s(m - \bar{p}) + (1 - s)(m^* - \bar{p}^*), \quad (3)$$

The home consumer price index is

$$\bar{p} = sp + (1 - s)(p^* + e), \quad (4)$$

where e is the exchange rate defined as the home price of a foreign currency unit. The home and foreign consumer baskets of goods have the same composition, therefore purchasing power parity holds,

$$e = \bar{p} - \bar{p}^*. \quad (5)$$

The production function has labor as input,

$$y = \alpha l, \quad (6)$$

$$y^* = \alpha l^*, \quad (7)$$

where l and l^* is employed labor and $0 < \alpha < 1$. Firms face monopolistic competition, and as shown in Appendix A.1, they set the relative price of their goods according to

$$p - \bar{p} = \frac{\alpha(w - \bar{p}) + (1 - \alpha)\bar{y}}{\alpha + \eta(1 - \alpha)}, \quad (8)$$

$$p^* - \bar{p}^* = \frac{\alpha(w^* - \bar{p}^*) + (1 - \alpha)\bar{y}}{\alpha + \eta(1 - \alpha)}, \quad (9)$$

where constant terms are ignored, since constants do not affect the main results of this model.

The nominal money demand is an increasing function of the amount of nominal transactions in a country, and it is a decreasing function of the nominal interest rate,

$$m = b(p + y) - cr, \quad (10)$$

$$m^* = b(p^* + y^*) - cr^*, \quad (11)$$

where r is the nominal wage, $0 < b < 1$ and $c > 0$. As in Rogoff (1985a), the income elasticity of money demand b is below unity, which ensures that the IS curve slopes

downward. The unemployment rate is defined as

$$u = l_0 - l, \quad (12)$$

$$u^* = l_0^* - l^*, \quad (13)$$

where l_0 and l_0^* are the constant labor supplies of the two countries. Interest rate parity holds,

$$r = r^* + E\{e\} - e, \quad (14)$$

where $E\{e\}$ is the expected future exchange rate. Note that when labor unions set wages in the first stage of the game, they assume correctly the level of the expected future exchange rate, which they need for their calculations. Hence $E\{e\}$ is a constant in the subsequent stages of the game.

Equations (1)-(14) provide the subgame equilibrium in the third stage of the game for fourteen variables as a function of w , w^* , r , r^* , which are given from stages one and two. The variables of interest for our purpose are the unemployment rate and the price level. Omitting constant terms, the unemployment rate is

$$u = \delta[sr + (1-s)r^*] + (1-s)\sigma(r - r^*) + \sigma w - (\sigma - 1)[sw + (1-s)w^*], \quad (15)$$

where $\delta = \frac{c}{1-b} > 0$ and $\sigma = \frac{\eta}{\alpha + (1-\alpha)\eta} > 1$, because $\eta > 1$. The signs of the partial derivatives are $u_r > 0$, $u_{r^*} \geq 0$, $u_w > 0$, $u_{w^*} < 0$. Note that $u_{r^*} > 0$ if $\delta > \sigma$ which is known as a locomotive effect. Otherwise, $u_{r^*} < 0$, which is known as a beggar-thy-neighbor effect. The term δ shows the impact of the aggregate world interest rate and σ shows the impact of an exchange rate appreciation on unemployment, given the expected exchange rate, which follows from the derivative of (14), $d(r - r^*) = -de$.

In an open economy monetary policy has two effects on unemployment, an income

effect and a substitution effect. The income effect is due to the average world interest rate, which affects the global demand for goods. The substitution effect is due to the exchange rate, which affects the substitution of the demand for goods between the two countries. In the case of domestic monetary policy the two effects act in the same direction. A rise in the home interest rate reduces world income and appreciates the home currency, thus home unemployment increases. In the case of foreign monetary policy, the two effects act in opposite directions. A rise in the foreign interest rate reduces the world income, but it depreciates the home currency. The net effect on home unemployment depends on whether the substitution or the income effect is stronger. The impact of wages is as follows: A wage rise makes the domestic goods relatively more expensive and consumers substitute the domestic goods with foreign goods, favoring production and employment in the foreign country. Omitting constant terms, the consumer price level is

$$\bar{p} = -(1 - \alpha) \delta [sr + (1 - s)r^*] - (1 - s)(r - r^*) + \alpha [sw + (1 - s)w^*]. \quad (16)$$

The signs of the partial derivatives are $\bar{p}_r < 0$, $\bar{p}_{r^*} \geq 0$, $\bar{p}_w > 0$, $\bar{p}_{w^*} > 0$. Note that $\bar{p}_{r^*} > 0$ if $\frac{1}{1-\alpha} > \delta$ and otherwise $\bar{p}_{r^*} < 0$. In an open economy monetary policy affects the consumer price level through two channels: first, by affecting world income, which is a function of $sr + (1 - s)r$, and second, by affecting the exchange rate, which is a function of $r - r^*$. When the domestic interest rate rises, these two effects add up, because income falls and the home currency appreciates, which both reduce the price level, yielding $\bar{p}_r < 0$. When the foreign interest rate rises, these two effects subtract, because although the world income falls, the home currency depreciates, and thus the net effect is ambiguous, $\bar{p}_{r^*} \geq 0$.

A wage rise at home or abroad increases the price level, proportionally to the weight

of the country's goods in the consumer basket.

2.2 Central banks

In the second stage of the game each central bank sets the money supply given nominal wages and the other central bank's money supply. The central banks minimize Kydland-Prescott-Barro-Gordon type objectives,

$$\min_r u^2 + I\bar{p}^2 \quad \text{and} \quad \min_{r^*} u^{*2} + I^*\bar{p}^{*2}, \quad (17)$$

where the relative weights I and I^* measure the degree of conservativeness of the central banks and u and \bar{p} are given in (15) and (16). The price level is tantamount to inflation, $\bar{\pi} = \bar{p} - \bar{p}_0$, where \bar{p}_0 is normalized to zero. The foreign unemployment rate u^* is obtained by interchanging stars as well as s and $1 - s$ in (15). The foreign price level \bar{p}^* is obtained similarly from (16). The rearranged first-order conditions are

$$\bar{p} = \frac{u_r}{I(-\bar{p}_r)}u, \quad (18a)$$

$$\bar{p}^* = \frac{u_{r^*}^*}{I^*(-\bar{p}_{r^*}^*)}u^*. \quad (18b)$$

These equations show that the central banks set the interest rates in such a way that inflation is proportional with unemployment (note that the coefficient $\bar{p}_r < 0$). The Nash equilibrium interest rates as a function of wages are presented in Appendix A.2.

2.3 The overturn of the beggar-thy-neighbor effect

Next we look at the impact of foreign monetary policy on the home economy. This is a crucial step in identifying the mechanism by which foreign conservativeness affects the economy. We know from (15) that foreign conservativeness has either a beggar-thy-

neighbor or a locomotive effect on home unemployment. The next proposition shows that even if foreign monetary policy has a beggar-thy-neighbor effect, the optimal reaction of the home central bank overturns it into a locomotive effect.

Proposition 1 *Given nominal wages, a foreign monetary contraction, followed by the best response of the home central bank, raises both the home unemployment rate and the home price level, i.e. $\frac{du}{dr^*} > 0$ and $\frac{d\bar{p}}{dr^*} > 0$.*

Proof. See Appendix A.3. ■

The reason for this reaction by the home central bank is that the foreign interest rate rise creates a negative externality, which reduces the utility of the home central bank. The utility falls because of the rise in the home unemployment rate or the home price level or both.² The optimal reaction of the home central bank is to distribute the burden evenly between unemployment and inflation, in accordance with the central bank's first-order condition. Hence, the optimal reaction is either an increase or a reduction of the home interest rate, which insures that both the unemployment rate and the price level rise proportionately. Thus, the final effect of a foreign interest rate rise is a locomotive effect on home unemployment, meaning that the downturn of the foreign economy is followed by a downturn in the home economy. Consequently, even if the foreign monetary policy by itself has a beggar-thy-neighbor effect, the optimal reaction of the home central bank overturns it into a locomotive effect. The overturn of the beggar-thy-neighbor effect is more general than the specific context of this paper: It also holds if the labor market is competitive or if there are no strategic interactions with labor unions.

²For a proof that a foreign interest rate rise reduces the utility of the home central bank, see Appendix A.4.

2.4 Labor unions

In the first stage of the game the nominal wages are set. The countries have n and n^* labor unions, respectively. A labor union prefers a higher real wage and lower unemployment and inflation, as in Coricelli, Cukierman, and Dalmazzo (2006). Labor union j minimizes the objective function with respect to its nominal wage w_j ,

$$\min_{w_j} - (w_j - \bar{p}) + \frac{A}{2}u_j^2 + \frac{B}{2}\bar{\pi}^2, \quad (19)$$

where A and B are weights representing the degree of unemployment and inflation aversion, respectively. The labor union dislikes a higher price level because it reduces the real wage, but also because it increases inflation, since $\bar{\pi} = \bar{p}$. The labor union's first-order condition is

$$- \left(1 - \frac{d\bar{p}}{dw_j} \right) + Au_j \frac{du_j}{dw_j} + B\bar{p} \frac{d\bar{p}}{dw_j} = 0. \quad (20)$$

Substituting (18a) into the above equation and assuming equal labor unions, $u_j = u$, allows to express the equilibrium unemployment rate as

$$u_j = u = \frac{1 - \frac{d\bar{p}}{dw_j}}{A \frac{du_j}{dw_j} + B \frac{u_r}{nI(-\bar{p}_r)} \frac{d\bar{p}}{dw_j}}, \quad (21)$$

where the elasticity $\frac{d\bar{p}}{dw_j}$ represents the threat of the price level for labor union j , because it reflects the impact of the labor union's wage claim on the price level. Similarly, $\frac{du_j}{dw_j}$ represents the unemployment threat to labor union j , because it reflects the impact of the labor union's wage claim on its own unemployment rate. This result shows that a rise of either the price level threat or the unemployment threat reduces the equilibrium unemployment rate (noting that $\bar{p}_r < 0$). Defining the average wage in

the home country as $w = \sum_1^n w_j/n$, the price threat is obtained as

$$\frac{d\bar{p}}{dw_j} = \frac{d\bar{p}}{dw} \frac{dw}{dw_j} = \frac{d\bar{p}}{dw} \frac{1}{n}, \quad (22)$$

which shows that the larger the number of labor unions, the weaker is the price threat internalized by labor union j .

Similarly to the demand for a certain good, the demand for labor of type j is a function of the aggregate demand for labor and the relative price of labor, that is,³

$$u_j = \sigma (w_j - w) + u, \quad (24)$$

where $\sigma = \frac{\eta}{\alpha + (1-\alpha)\eta} > 1$ is the elasticity of labor with respect to the relative wage. This is due to the substitutability of labor among labor unions, which in this model happens indirectly, through the product markets. The derivative of (24) with respect to the wage yields the unemployment threat,

$$\frac{du_j}{dw_j} = \sigma \left(1 - \frac{1}{n} \right) + \frac{1}{n} \frac{du}{dw}. \quad (25)$$

The unemployment threat is decomposed into two parts. The first part is due to the substitution of labor among labor unions and the second part is due to the general rise of the unemployment rate in the economy. Monetary policy only affects the second part. Substituting (22) and (25) into (21) yields the equilibrium unemployment rate,

$$u = \frac{1 - \frac{1}{n} \frac{d\bar{p}}{dw}}{A \left[\sigma \left(1 - \frac{1}{n} \right) + \frac{1}{n} \frac{du}{dw} \right] + B \frac{u_r}{nI(-\bar{p}_r)} \frac{d\bar{p}}{dw}}, \quad (26)$$

³Equation (24) can be obtained from equations (1), (8), (30), (32) with unknown variables y_j , p_j , p , \bar{p} , which yields

$$y_j = -\frac{\alpha\eta}{\alpha + (1-\alpha)\eta} (w_j - w) + y. \quad (23)$$

Using equations (29) and (12) in (23) yields the result in equation (24).

where the elasticities $\frac{d\bar{p}}{dw}$ and $\frac{du}{dw}$ are obtained by taking the derivative of (15) and (16) with respect to the home wage, which yields

$$\frac{d\bar{p}}{dw} = \bar{p}_r r_w + \bar{p}_{r^*} r_w^* + \bar{p}_w, \quad (27)$$

$$\frac{du}{dw} = u_r r_w + u_{r^*} r_w^* + u_w, \quad (28)$$

where r_w and r_w^* are the derivatives of equation (37) in Appendix A.2 and its foreign counterpart with respect to the home wage. The equilibrium price level is obtained by substituting (26) into (18a). Note that the number of labor unions in the foreign country does not affect the home country, and hence the foreign country may even have a decentralized labor market, so that $n^* \rightarrow \infty$.

3 Foreign conservativeness

First, this section presents the special case of a monopoly labor union that is not inflation averse, which highlights the importance of foreign conservativeness, and second it presents the general case.

3.1 A monopoly labor union that is not inflation averse

Let us assume that there is a single labor union in the home country, $n = 1$, that is not inflation averse, $B = 0$, and for simplicity, the countries have the same size, $s = 1/2$. The equilibrium unemployment rate shown in equation (26) takes on the special form,

$$u = \frac{(\delta + \sigma) [1 + (1 - \alpha) \sigma] + 2(1 - \alpha) [1 + (1 - \alpha) \delta] I^*}{A \{2\sigma(\delta + \sigma) + [1 + (1 - \alpha) \sigma] [1 + (1 - \alpha) \delta] I^*\}}.$$

Strikingly, the equilibrium home unemployment rate does not depend on home conservativeness, I . This is a well-known result from the closed economy literature, such as Coricelli, Cukierman, and Dalmazzo (2006). Their result is replicated if $s = 1$ is assumed, so that $u = (1 - \alpha)/A$. This paper extends this result to the open economy, where the irrelevance of home conservativeness still holds. The reason for this irrelevance is that higher home conservativeness creates a tighter reaction of monetary policy to a wage increase. Therefore, the labor union faces an increased threat of unemployment, but a reduced threat of the price level. In this special case, the lower price level threat exactly offsets the higher unemployment threat. As a result, domestic conservativeness has no impact on equilibrium unemployment.

In contrast, the home unemployment rate is affected by foreign conservativeness, I^* . The higher foreign conservativeness, the lower is the unemployment rate. Hence, this special case emphasizes the relevance of foreign conservativeness: Even though domestic conservativeness may not affect the real economy, one can still find an effect from foreign conservativeness. The mechanism is explained below.

3.2 The general case of inflation averse labor unions

Domestically, a labor union's wage rise generates a rise in the unemployment rate and in the price level. Both of these adverse effects of the wage rise deter the labor union from raising the wage above an optimal level. As it turns out, the foreign central bank amplifies both the unemployment and the price level threat.

Proposition 2 *The equilibrium home unemployment rate and the price level decrease in the conservativeness of the foreign central bank, i.e. $\frac{du}{dI^*} < 0$ and $\frac{d\bar{p}}{dI^*} < 0$.*

Proof. See Appendix A.5. ■

When the labor union is setting the wage, it is considering the impact of its wage rise on itself. A home wage rise reduces foreign unemployment, (due to the substitution of the home goods with foreign goods, see (15)), and it increases the foreign price level (due to imported inflation, see (16)). As a consequence, the foreign central bank reacts by unambiguously raising the foreign interest rate. The more conservative the foreign central bank, the more it raises the interest rate in response to a home wage rise. That reduces the utility of the home central bank and following its the best response, as Proposition 1 shows, both the unemployment rate and the price level rise in the home country. This threat of unemployment and inflation deter the labor union's wage rise. A more conservative foreign central bank will exercise a higher threat on the home labor union. Due to the higher threat, the labor union will choose a lower wage.⁴

3.3 Home versus foreign conservativeness

In contrast with foreign conservativeness, home conservativeness does not increase both types of threats.⁵ A rise in home conservativeness generates a more contractionary monetary policy reaction against a wage rise, and hence it increases the unemployment threat, and it reduces the price level threat. Thus, the sign of the impact of home conservativeness depends on which of the two threats dominates. If the labor union is sufficiently inflation averse, then the price threat dominates the unemployment threat. Thus, a rise in domestic conservativeness diminishes the price threat, it weakens the self-moderation of the labor union's wage claims, and therefore, the equilibrium unemployment rate rises. In this case a rise in domestic conservativeness is not beneficial, whereas a rise in foreign conservativeness is beneficial for the home

⁴The impact of foreign conservativeness on the home economy is nil if $n \rightarrow \infty$, $s \rightarrow 0$ or $s \rightarrow 1$, but n^* does not affect it.

⁵Coricelli, Cukierman and Dalmazzo (2006) provide a detailed analysis of the impact of domestic conservativeness.

economy.

Lippi (2003) introduces direct labor substitution between labor unions and shows that the impact of domestic conservativeness depends also on the elasticity of labor substitution. If a labor union's wage increase raises its unemployment rate because its labor is substituted with the workforce of other labor unions, then that overshadows the impact of monetary policy on unemployment. The higher labor substitution is, the less attention the labor union pays to the unemployment threat of monetary policy. Thus, the role of labor substitution is similar to the role of a labor union's inflation aversion, in the sense that it reduces the importance of the unemployment threat relative to the inflation threat of monetary policy. Therefore, domestic conservativeness, which increases the unemployment and reduces the inflation threat, has a deterrent effect only if the elasticity of labor substitution is not too high. However, foreign conservativeness, which raises both the unemployment threat and the inflation threat, has a deterrent effect for any level of labor substitution.

4 Conclusions

This paper investigates the impact of foreign monetary policy on the home economy. The effect of an increase in foreign conservativeness is carried through the exchange rate, which is flexible, although the home central bank intervenes optimally to neutralize any unwanted exchange rate effect from abroad, such as the beggar-thy-neighbor effect on output. In this sense, competitive depreciations or exchange rate interventions may be seen as optimal responses by central banks to achieve internal policy goals, rather than policy changes to manipulate the exchange rate. The overturn of the beggar-thy-neighbor effect holds also in a non-unionized economy.

The policies of open economies are strongly interrelated, and for this reason, it

is useful to understand the mechanism that connects them. In essence, the difference between the impact of home and foreign conservativeness is the following: Home conservativeness increases the threat of unemployment, but it reduces the threat of inflation. If the labor union places a larger weight on the price level than on unemployment, then its wage claims are encouraged. In contrast, foreign conservativeness deters home wage claims by raising both the threat of unemployment and inflation. Therefore, the higher the level of foreign conservativeness, the better it is for the home economy. It follows, that the home country prefers an ultra-conservative foreign central bank.

This preference could explain, for instance, the earlier efforts of Germany to remove the liberal or non-conservative monetary policies in Europe by creating a common monetary policy. Although the Bank of England did not subordinate monetary policy, still it achieved a substantial rise in conservativeness in 1997, when it gained independence from the treasury and it introduced inflation targeting, and in that way, it contributed to European welfare. Furthermore, this mechanism suggests that countries outside the euro-zone also experience a beneficial effect, when their trading partner countries start pegging the exchange rate to the euro and thus, effectively borrow the highly conservative monetary policy of the ECB.

A Appendix

A.1 The firm's problem

A fraction of the continuum of firms in a country employs labor from union j . The representative firm using labor union j is denoted by firm j . The production function of firm j is,

$$y_j = \alpha l_j, \tag{29}$$

where $0 < \alpha < 1$. The demand faced by firm j is

$$y_j = -\eta(p_j - \bar{p}) + \bar{y}. \quad (30)$$

Let capital letters represent the antilogs of small case variables. The real profit of firm j is

$$\frac{P_j}{\bar{P}} Y_j - \frac{W_j}{\bar{P}} L_j. \quad (31)$$

Firms face monopolistic competition and choose the price to maximize profit. By substituting the antilogs of (29) and (30) into (31) the problem of the firm becomes

$$\max_{P_j} \left(\frac{P_j}{\bar{P}} \right)^{1-\eta} \bar{Y} - \frac{W_j}{\bar{P}} \left[\left(\frac{P_j}{\bar{P}} \right)^{-\eta} \bar{Y} \right]^{1/\alpha}.$$

The infinitesimal firm takes the price level \bar{P} and the wage W_j as given. Calculating the first order conditions and taking logarithms yields

$$p_j - \bar{p} = \theta + \frac{\alpha(w_j - \bar{p}) + (1 - \alpha)\bar{y}}{\alpha + \eta(1 - \alpha)}, \quad (32)$$

where $\theta \equiv \alpha / [\alpha + \eta(1 - \alpha)] \log [\eta / \alpha(\eta - 1)] > 0$. The average price over all labor unions in the home country is defined as $p = \frac{1}{n} \sum_{j=1}^n p_j$. Taking the average of both sides of equation (32) yields equation (8).

A.2 The equilibrium in the second stage of the game

The central bank's first-order condition (18a) can be rewritten using (15) and (16) in the form

$$\begin{aligned} & (u_r r + u_{r^*} r^* + u_w w + u_{w^*} w^*) u_r + \\ & (\bar{p}_r r + \bar{p}_{r^*} r^* + \bar{p}_w w + \bar{p}_{w^*} w^*) I \bar{p}_r = 0. \end{aligned} \quad (33)$$

Expressing the interest rate yields the best response of the central bank,

$$r = a_0 r^* + a_1 w + a_2 w^*, \quad (34)$$

where

$$a_0 = -\frac{u_{r^*} u_r + \bar{p}_{r^*} I \bar{p}_r}{u_r^2 + I \bar{p}_r^2}, \quad a_1 = -\frac{u_w u_r + \bar{p}_w I \bar{p}_r}{u_r^2 + I \bar{p}_r^2}, \quad a_2 = -\frac{u_{w^*} u_r + \bar{p}_{w^*} I \bar{p}_r}{u_r^2 + I \bar{p}_r^2}. \quad (35)$$

The best response of the foreign central bank is

$$r^* = a_0^* r + a_1^* w^* + a_2^* w, \quad (36)$$

which is obtained by interchanging stars on (34). The Nash equilibrium given wages is obtained by solving the equations (34) and (36), which yields

$$r = -\frac{(a_1 + a_0 a_1^*) w + (a_2 + a_0 a_2^*) w^*}{a_0 a_0^* - 1}. \quad (37)$$

The equation for the foreign country is obtained by interchanging the stars on the variables in (37). A wage rise may affect the interest rate either way, depending on the underlying parameters. This is clearly reflected in the following special case. If

the relative size of the country is $s = 1$, equation (37) simplifies to

$$r = -\frac{1 - (1 - \alpha) \alpha I}{\delta [1 + (1 - \alpha)^2 I]} w, \quad (38)$$

which is a familiar expression from Coricelli, Cukierman, and Dalmazzo (2006). The difference consists in the presence of δ , which is due to the fact that in our model the money demand is a function of the interest rate. This shows that the central bank reacts to a wage rise by raising the interest rate if and only if it is sufficiently conservative. The more conservative the central bank, the more monetary policy contracts or the less it expands in response to a wage rise, as shown by the derivative

$$\frac{d^2 r}{dw dI} = \frac{1 - \alpha}{\delta [1 + (1 - \alpha)^2 I]^2} > 0. \quad (39)$$

A.3 Proof of Proposition 1

In the second stage of the game the wages are preset by the labor unions and are treated as constants. The derivative of (15) with respect to r^* given $dw = 0$ and $dw^* = 0$ is

$$\frac{du}{dr^*} = u_r r_{r^*} + u_{r^*}.$$

Substituting the expression for r_{r^*} from (34) into the above and rearranging yields

$$\frac{du}{dr^*} = \frac{\bar{p}_r I (\bar{p}_r u_{r^*} - \bar{p}_{r^*} u_r)}{u_r^2 + I \bar{p}_r^2}.$$

This expression is positive, because $\bar{p}_r < 0$ and

$$\bar{p}_r u_{r^*} - \bar{p}_{r^*} u_r = -\frac{\alpha (1 - s) \delta}{\alpha + (1 - \alpha) \eta} < 0. \quad (40)$$

That is, $\frac{du}{dr^*} > 0$. Taking the derivative of (18a) with respect to r^* yields

$$\frac{d\bar{p}}{dr^*} = -\frac{u_r}{I\bar{p}_r} \frac{du}{dr^*} > 0.$$

A.4 Proof that the foreign interest rate rise reduces the utility of the home central bank

The loss function of the home central bank is $\Omega = u^2 + I\bar{p}^2$. We will show that $\frac{d\Omega}{dr^*} > 0$. The derivative with respect to the foreign interest rate is

$$\frac{d\Omega}{dr^*} = 2uu_{r^*} + 2I\bar{p}\bar{p}_{r^*}.$$

However, u and \bar{p} have optimal levels set by the home central bank according to its first order condition (18a). Substituting $\bar{p} = -\frac{u_r}{I\bar{p}_r}u$ into the above expression yields

$$\frac{d\Omega}{dr^*} = \frac{2u}{\bar{p}_r} (\bar{p}_r u_{r^*} - \bar{p}_{r^*} u_r) > 0,$$

which is positive, because $\bar{p}_r < 0$ and $\bar{p}_r u_{r^*} - \bar{p}_{r^*} u_r < 0$, as shown in (40).

A.5 Proof of Proposition 2

The derivative of the unemployment rate in (26) with respect to foreign conservativeness is

$$\frac{du}{dI^*} = -\frac{1}{g^2} \left[\frac{1}{n} \frac{d^2\bar{p}}{dI^*dw} g + f \left(A \frac{1}{n} \frac{d^2u}{dI^*dw} + B \frac{u_r}{nI(-\bar{p}_r)} \frac{d^2\bar{p}}{dI^*dw} \right) \right],$$

where $f > 0$ and $g > 0$ are the numerator and the denominator of (26), respectively. The numerator $f = 1 - \frac{d\bar{p}_j}{dw_j} > 0$, shows that a nominal wage rise increases the real wage, and this must be positive, otherwise the labor union would have no incentive to

set a positive nominal wage. Likewise, the denominator $g = A \frac{du_j}{dw_j} + B \frac{u_r}{nI(-\bar{p}_r)} \frac{d\bar{p}}{dw_j} > 0$, which represents the cost of unemployment and inflation for the labor union, must be positive, otherwise the labor union would increase the nominal wage without limit. The derivative of $\frac{d\bar{p}}{dw}$ with respect to I^* is obtained from equation (27), which yields

$$\frac{d^2\bar{p}}{dI^*dw} = \gamma [s\delta + (1-s)\sigma] \{ (1-\alpha)\delta + s(1-s)[1 - (1-\alpha)\delta]^2 \} > 0, \quad (41)$$

where $\gamma = Is(1-s)[s\sigma + (1-s)\delta]/D^2 > 0$ and D^2 is the square of the denominator. The derivative of $\frac{du}{dw}$ with respect to I^* is obtained from equation (28), which yields

$$\frac{d^2u}{dI^*dw} = \gamma I [s\delta(1-\alpha) + (1-s)]^2 [(1-s)\delta(1-\alpha) + s] > 0.$$

Thus the inequalities $\frac{d^2\bar{p}}{dI^*dw} > 0$ and $\frac{d^2u}{dI^*dw} > 0$ imply that $\frac{du}{dI^*} < 0$. Using this result in (18a) implies that also $\frac{d\bar{p}}{dI^*} < 0$.

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