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with non-atomistic wage setters

by Vincenzo Cuciniello

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THE WELFARE EFFECT OF FOREIGN MONETARY CONSERVATISM WITH NON-ATOMISTIC WAGE SETTERS

by Vincenzo Cuciniello*

Abstract

This paper extends the closed economy analysis of strategic interaction between labor unions and the monetary authority in Lippi (REStud 2003) to a two-country open economy framework. It sheds light on the real effect of foreign central bank conservatism, which—through a strategic mechanism that operates via the terms of trade between the two independent monetary policy makers—entails wage moderation. The impact of domestic central bank conservatism hinges instead on the combination of three strategic effects.

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Keywords: foreign central bank conservatism, centralized wage setting, open-economy macro.

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1 Introduction¹

Strategic monetary policy literature points out that central bank aversion to inflation (“conservatism” as defined by Rogoff (1985)) has real effects on equilibrium outcomes in presence of non-atomistic wage setters (e.g. Lippi 2003, Coricelli et al. 2004, Soskice and Iversen 2000, Bratsiotis and Martin 1999).² Intuitively, a large trade union understands that an increase in its members’ wage not only leads to higher inflation, but also prompts a monetary response which depends on the degree of conservatism.

These studies have mainly focused on two strategic channels through which central bank conservatism prompts unions to modify their wage demands. First, as nominal wages are negotiated taking as given the nominal wages of the other unions, each union anticipates inflationary pressures curtailing the other unions’ real wages. This reduction makes labor services provided by other unions more competitive, thereby triggering labor substitution across firms. Central bank conservatism may, however, encourage wage demands, since it decreases the decline in the other unions’ real wages by curbing inflation. Such a mechanism is known as “substitution effect” (e.g. Cukierman and Lippi 1999, Lippi 2003). Second, strong central bank preference for price stability renders monetary policy tighter. Therefore, a conservative central bank increases the elasticity of aggregate labor demand to nominal wage hikes. This channel, which Lippi (2003) calls “output effect,” has been extensively studied in the past decade (e.g. Bratsiotis and Martin 1999, Soskice and Iversen 1998, 2000, Coricelli et al. 2004, 2006, Gnocchi 2009).

Yet in an open-economy setting there is a third mechanism that operates through the trade channel. Holding foreign prices constant, an increase in wages improves the terms of trade and causes expenditure in both countries to switch from the domestically produced good to the foreign produced good. At the same time, this favorable shift in the terms of trade drives up the relative real wage of domestic worker and so produces a “beggar-thy-neighbor” welfare spillover in the sense that the burden of labor input into production switches from domestic workers to foreign workers (“terms-of-trade effect”).

Early contributions on optimal monetary policymaking in the presence of large unions do not investigate these three strategic channels simultaneously. The main novelty of the present paper is to embed all of them within a single micro-founded framework. Drawing on Corsetti and Pesenti (2001), I introduce an open-economy dimension in the Lippi’s (2003) setting. In this

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²See Cukierman (2004) and Calmfors (2001) for a review of this literature.

case, foreign conservatism results in welfare gains by inducing wage moderation. Intuitively, as long as higher domestic inflation created by domestic wage setters is perceived as improving the terms of trade, there is an incentive to raise wages. This incentive is, however, lessened by foreign monetary conservatism, which, restraining the adjustment of the exchange rate, reduces relative inflation in the domestic country.

This theoretical result finds empirical support in the experience of the European countries in the wake of Paul Volcker’s appointment as chairman of the U.S. Federal Reserve. During the Volcker disinflation from 1979:Q3 to 1987:Q3, the Fed acquired credibility for low inflation. At the same time, as illustrated in Figure 1, this aggressive monetary policy tightening was accompanied by falling wage growth rates in Europe, where negotiations generally involve strong trade unions that set wages at the national or industry level (see Nickell et al. 2005).

Figure 1: European Wage Rate (Four-Quarter Growth Rate)



Notes: The gray band indicates Paul Volcker’s period as Fed Chairman. Data for the euro area are drawn from the Area Wide Model dataset (Fagan et al. 2001).

The final part of the paper fleshes out how domestic conservatism and centralization of wage setting affect real outcomes. Installing a monetary authority that is more inflation averse than society leads labor unions to anticipate a smaller inflationary impact from the increase in their nominal wage. The resulting “beggar-thy-neighbor” incentive to move the terms of trade through inflationary pressure is impeded, while the substitution effect stemming from firms becomes looser. Similarly, the presence of more concentrated labor markets has the overall effect of dampening the substitution mechanism relative to the incentive to use strategically the terms

of trade. It turns out that the condition determining the welfare gains from domestic monetary conservatism and centralization of wage setting depends not only on the output effect, as in Lippi (2003), but also on the term-of-trade effect. Specifically, domestic aversion to inflation and more centralized wage setting are welfare maximizing when the output *and* terms-of-trade effects dominate the substitution effect.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 describes the equilibrium solution of the non-cooperative policy game. Section 4 disentangles the welfare effects of each strategic mechanism and of monetary conservatism and centralization of wage setting. Section 5 concludes.

2 The model

The model combines monopolistic competition and nominal rigidities in the labor market. The economy consists of two equally-sized countries, Home (H) and Foreign (F). Each country is specialized in the production of a traded good that can be manufactured in a variety of brands. Each brand in turn is produced by a monopolistically competitive firm. Prices are perfectly flexible.³ Money enters the model via a cash-in-advance constraint. There are no impediments or costs to trade across borders, so the law of one price holds and both countries are assumed to have freely floating exchange rates. Wages are contractually fixed for one period (contract period in the sequel)⁴ and are set by a finite number of unions.

The timing is as follows. At the beginning of the contract period, monopolistic unions simultaneously set nominal wages in their country of origin anticipating the monetary policy. Next, monetary policy is simultaneously conducted in each country by a conservative central bank. Finally, households consume while firms set prices and hire labor.

2.1 Households

Each country is populated by a continuum of measure one of identical households. Members in each family are indexed by $j \in [0, 1]$. Foreign variables are denoted with an asterisk. Households preferences are given by

$$(1) \quad U_t = \log C_t - \frac{k}{2} \int_0^1 [\log L_t(j)]^2 dj,$$

³The companion Appendix, posted on the author's homepage (now at <http://sites.google.com/site/vincenzocucinello>), presents an extension to partial price adjustment mechanisms and exchange rate pass-through. The main results still hold.

⁴Multi-period dynamics are not key to the strategic effects I will investigate here.

where $L(j)$ is the total amount of type j labor supplied by a household member and C denotes a Cobb-Douglas consumption index defined as

$$(2) \quad C_t = C_{Ht}^\gamma C_{Ft}^{1-\gamma} \quad 0 < \gamma < 1,$$

where $C_H = \left(\int_0^1 C(h)^{(\phi-1)/\phi} dh \right)^{\phi/(\phi-1)}$ and $C_F = \left(\int_0^1 C(f)^{(\phi-1)/\phi} df \right)^{\phi/(\phi-1)}$ indicate consumption bundles of the Home-produced traded good and of the Foreign-produced traded good respectively. The elasticity of substitution between brands produced within a given country is constant at $\phi > 1$.

The consumption-based price index aggregates over the price of the Home and Foreign goods in the Home country denominated in the Home currency and is defined as

$$(3) \quad P_t = \frac{1}{\gamma^\gamma (1-\gamma)^{1-\gamma}} P_{Ht}^\gamma P_{Ft}^{1-\gamma},$$

where $P_H = \left(\int_0^1 P_H(h)^{1-\phi} dh \right)^{1/(1-\phi)}$ and $P_F^* = \left(\int_0^1 P_F^*(f)^{1-\phi} df \right)^{1/(1-\phi)}$.

In the absence of market segmentation across countries, the law of one price holds, $P_{Ft} = \mathcal{E}_t P_{Ft}^*$ and $P_{Ht}^* = P_{Ht} / \mathcal{E}_t$, where \mathcal{E} is the nominal exchange rate (domestic currency per unit of foreign currency), and P_H^* and P_F^* are respectively the prices of Home and Foreign goods in Foreign currency.

At the beginning of each period households enter with nominal balances M_{t-1} and receive a lump-sum transfer, $(x_t - 1)M_{t-1}^s$, from the Home government, where x_t is the gross growth rate of the Home money supply, M_{t-1}^s . Seignorage revenue is thrown away at the end of every period. The representative household splits into a worker and a shopper. Trading takes place as follows. The shopper needs cash in advance to pay for nominal expenses, thereby facing the following constraint⁵

$$(4) \quad \int_0^1 P_t(h) C_t(h) dh \leq M_{t-1} + (x_t - 1)M_{t-1}^s.$$

The household budget constraint is given by

$$(5) \quad \int_0^1 P_t(h) C_t(h) dh + M_t = M_{t-1} + (x_t - 1)M_{t-1}^s + D_t + \int_0^1 W_t(j) L_t(j) dj,$$

where D are dividends from ownership of domestic firms and M_t denotes domestic money to take into the next period. I assume that the wage for each labor type, $W(j)$, is set by a union representing that type of labor. For a given wage, $W(j)$, each worker supplies the quantity of labor, $L(j)$, that is determined by the aggregation of firms' labor demand decisions (and

⁵Note that the assumption of Cobb-Douglas preferences over traded goods in conjunction with zero initial bond holdings entails the redundancy of global securities market (see Corsetti and Pesenti 2001).

allocated uniformly across households). Thus, both $W(j)$ and $L(j)$ are taken as given by each individual household.

As in Erceg et al. (2000) and much of the subsequent literature, members of each family perfectly insure each other against variations in labor income so that they face the same budget constraint and make the same consumption choices even if they have different wages. Foreign households are modeled in an analogous way.

2.2 Firms

I assume a continuum of monopolistically competitive firms indexed by $h \in [0, 1]$, each producing a differentiated brand of the Home good. Firms set prices in every period and produce output, $Y(h)$, according to the following production technology

$$(6) \quad Y_t(h) = L_t(h)^\alpha = \left[\int_0^1 L_t(h, j)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\alpha\sigma}{\sigma-1}} \quad 0 < \alpha < 1, \sigma > 1,$$

where σ is the elasticity of input substitution, $L(h, j)$ denotes the demand of a typical firm residing in the Home country for labor services j supplied by domestic workers

$$(7) \quad L_t(h, j) = \left[\frac{W_t(j)}{W_t} \right]^{-\sigma} L_t(h),$$

and W indicates the nominal wage index defined as

$$(8) \quad W_t = \left[\int_0^1 W_t(j)^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}}.$$

Aggregate output is obtained by integrating across firms $Y_t = \int_0^1 Y_t(h) dh$.

Each firm in any given period chooses the price of brand so as to maximize profit subject to demand. The profit function for a typical producer is as follows

$$(9) \quad D_t(h) = P_{Ht}(h)Y_{Ht}(h) - W_tY_{Ht}(h)^{1/\alpha}.$$

As shown in the companion Appendix, the global demand function for the representative brand produced in the Home country is given by

$$(10) \quad Y_{Ht}(h) = \gamma \left(\frac{P_{Ht}(h)}{P_{Ht}} \right)^{-\phi} TOT_t^{1-\gamma} (C_t + C_t^*),$$

where the terms of trade in the Home country, $TOT \equiv \frac{\mathcal{E}P_F^*}{P_H}$, is defined as the price of imports relative to the price of exports, denominated in the Home currency.

2.3 Conservative central banks

Monetary policy is conducted by a Rogoff-conservative central bank in each country (Rogoff 1985). I draw on Lippi (2003) and assume that the objective function of the monetary authority is modeled as follows

$$(11) \quad \Omega_t = U_t - \frac{\beta}{2} p_t^2 \quad \beta > 0,$$

where β is a measure of monetary conservatism, U denotes the representative household's utility, (1), and $p \equiv \log P$.⁶ In any period t the central bank maximizes (11) with respect to the money supply, m_t , subject to the private sector equilibrium, namely a sequence of prices and quantities that clears all markets in every period.

Conventional wisdom suggests that an explicit mandate for the central bank to deliver a low and stable rate of inflation is an important institutional device to assure price stability (see e.g. Cukierman 1992).⁷ The Treaty on European Union and the Statute of the European System of Central Banks state that the European Central Bank has the primary goal of conducting monetary policy in order to maintain price stability. In this respect, the β parameter can be a way to model that institutional design. Henceforth, I assume that Home and Foreign central banks may have different preferences toward inflation, respectively β and β^* .

2.4 Unions

Workers are organized in $n > 1$ labor unions. All labor types are unionized and equally distributed across 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 unions' size: the fewer the unions, the more each union internalizes the impact of its own wage settlement on aggregate wage.

The simplifying assumption that all labor types are equally distributed across unions is quite common in the literature on non-atomistic wage setting. However, it is worth noticing that European unions are organized along industrial/professional lines.⁸ Since this would not add insights, but would make the model presentation more complicated, I simplify by not modeling this structure explicitly.

In any period t the representative union maximizes the utility functional of its members (of mass $1/n$)

⁶In what follows, I will denote the natural logarithm of any variable Z by the corresponding lower-case letter; thus $z \equiv \log Z$. Without loss of generality, I normalize the initial period nominal wage, money supply, and general price level to unity, so that the log of these variables are an approximation of their percentage increase.

⁷Another rationale explored in the literature is that central banks tend to take a longer view of the policy process than do politicians.

⁸Vartiainen (2002) and Holden (2003), for example, assume that unions are sectoral: in each country one union sets the wage in the tradable sector while another union sets the wage in the non-tradable sector.

$$(12) \quad V_{ut} = \log C_t - \frac{k}{2}n \int_{j \in u} [\log L_t(j)]^2 dj,$$

with respect to the wage rate, $w_t(u)$, subject to private sector equilibrium and optimal monetary stance.

3 Equilibrium

I assume a one-shot two-stage game. Nominal wages are set by unions in the first stage of the game in an uncoordinated way. They have full information about the reaction functions of the central banks and take them into account in the wage setting process. In other words, each union acts as Stackelberg leader vis-à-vis monetary authorities, while playing a Nash game against other unions. The equilibrium of this wage-setting game determines the growth of nominal wages in the two countries. In the second stage each central bank chooses its money supply simultaneously taking the other's money supply and nominal wages as given. Thus each monetary authority plays a Nash game against the other and acts as Stackelberg follower against unions. Finally, after having observed money balances and negotiated nominal wages, private sector (firms and households) responds with a sequence of prices and quantities that constitutes a monopolistically competitive equilibrium at every point in time.

The timing protocol in which wage setting is determined before monetary policy is in line with the literature on strategic interactions between central banks and unions (e.g. Soskice and Iversen 1998, 2000, Bratsiotis and Martin 1999). Moreover, it reflects the fact that wage contract are usually fixed for at least one year, while prices and the monetary stance can be adjusted more frequently. The game is solved by backward induction.

3.1 Monetary policy

In the second stage of the game the two central banks play Nash against each other, taking as given the nominal wage decisions made by both domestic and foreign unions in the first stage. The solution to monetary problem yields the following first-order condition

$$(13) \quad m_t = \frac{k - \beta(1 - \theta)\theta}{k + \beta\theta^2} w_t + \frac{\beta(1 - \theta^*)\theta}{k + \beta\theta^2} l_t^*,$$

where $\theta \equiv 1 - \alpha\gamma$ and $\theta^* \equiv 1 - \alpha(1 - \gamma)$.

Monetary response to domestic wages depends on the degree of central bank conservatism. Wage rises trigger inflationary pressures, but also a decrease in employment. It turns out that, when the degree of *domestic* conservatism is relatively high ($\beta > \frac{k}{\theta(1-\theta)}$), monetary policy

counteracts an increase in domestic wages so as to curb inflation. Conversely, when it is sufficiently low ($\beta < \frac{k}{\theta(1-\theta)}$) monetary policy accommodates an increase in nominal wages so as to boost employment. This result has been already investigated in the theoretical and empirical literature (e.g. Coricelli et al. 2004, Lippi 2003, Cukierman et al. 1998). However, in an open-economy setting ($\gamma < 1$), there is a further channel of interaction.

Result 1 *An increase in the degree of central bank conservatism leads to a more expansionary domestic monetary response to foreign employment.*

Intuitively, a rise in foreign money supply increases foreign employment and appreciates the domestic currency. The latter effect, however, improves the terms of trade in the Home country, thereby reducing the CPI. It turns out that the Home central bank is induced to expand its money supply due to the lower cost of an inflationary policy.

3.2 Wage setting and outcomes

Unions choose their wage in the first stage of the game simultaneously. Each of them takes the other unions' nominal wages as given and acts as Stackelberg leader vis-à-vis the two monetary authorities, thereby internalizing the central banks' reaction functions. As shown in the companion Appendix, the solution to the union's problem yields the following equilibrium inflation and employment

$$(14) \quad p = \frac{\alpha}{(1-\alpha\gamma)\beta} \left[\frac{1}{\eta} - (1-\gamma) \right],$$

$$(15) \quad l = \tilde{l} \left(1 - \frac{1}{\eta} \right),$$

where $\eta \equiv -\partial \log L(u) / \partial \log(W(u)/P) > 1$ is the real consumer wage elasticity (in absolute value) of the demand for all labor types $j \in u$ and $\tilde{l} \equiv \alpha/k$ is the efficient (log) employment level. As long as η is finite, equilibrium employment is below its efficient level, \tilde{l} , and a deflation bias occurs under certain circumstances. The intuition behind this result follows.

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 $1/\eta$ in equation (14)), 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. Money contraction not only reduces both

consumption and output, but 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 since 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 $-(1 - \gamma)$ in the square brackets in equation (14).

The real consumer wage elasticity of perceived labor demand, $\eta \equiv -\varepsilon_h/(1 - s_h)$, is composed of the elasticity of labor demand to nominal wage $W(u)$,

$$(16) \quad -\varepsilon_h \equiv -\frac{\partial \log L(u)}{\partial \log W(u)} = \sigma \left(1 - \frac{1}{n}\right) - \varepsilon_H \frac{1}{n} \equiv \sigma \left(1 - \frac{1}{n}\right) + \frac{\beta \theta}{k} s_h,$$

where s_h denotes the elasticity of inflation to nominal wage $W(u)$,

$$(17) \quad s_h \equiv \frac{\partial \log P}{\partial \log W(u)} = \frac{k(k + \beta^* \theta^{*2})}{k^2 + \beta \beta^* \theta \theta^* (1 - \alpha) + k(\beta \theta^2 + \beta^* \theta^{*2})} \frac{1}{n} \in (0, 1).$$

Equation (16) expresses the elasticity of domestic labor demand perceived by the u -th union as a weighted average of the elasticity of substitution across labor types and the elasticity of aggregate labor demand to changes in aggregate wage, $\varepsilon_H \equiv \partial \log L / \partial \log W$. The latter is a function of aggregate demand faced by firms that, in turn, hinges on monetary stance. Intuitively, domestic unions perceive an increase in wages as boosting domestic inflation through (17). This, in turn, triggers two effects. First, as the domestic good becomes more expensive, households reduce consumption of it and domestic labor demand falls. At the same time, higher domestic prices boost CPI inflation. Thus, monetary conservatism decreases domestic employment even further by curbing inflation.

It is worth noticing that atomistic wage setters ($n \rightarrow \infty$) neither internalize the impact of their wage claims on inflation (equation (17) is equal to zero) nor the repercussion on aggregate employment (equation (16) is equal to the elasticity of substitution σ). The weight of ε_H in (16) is in fact increasing with the union’s size (lower n). This result stems from the fact that the representative union anticipates that

$$(18) \quad \frac{\partial W}{\partial w(u)} = \frac{1}{n} \left(\frac{W(u)}{W} \right)^{-\sigma},$$

i.e. an increase in wage raises aggregate wage by $1/n$ in a symmetric equilibrium, $W(u) = W$. This leads to inflationary pressures through firms’ optimal price conditions, which, in turn, entail an aggregate demand reduction in the wake of conservative monetary policies.

The next section investigates the strategic mechanisms through which conservative monetary policy may induce wage restraint.

4 Analysis of labor demand elasticity η

4.1 Strategic mechanisms

In order to gain an insight into the strategic channels operating in η , it is convenient to rewrite the elasticities of labor demand to real wages η as follows:

$$(19) \quad \eta = \left[\underbrace{\frac{1}{\sigma}}_{\text{substitution effect}} \left(1 - \frac{\varepsilon_H}{n\varepsilon_h} \right) + \underbrace{(1-\alpha) \frac{\varepsilon_H}{n\varepsilon_h}}_{\text{output effect}} + \underbrace{\alpha(1-\gamma) \left(\frac{\varepsilon_H - \varepsilon_{H^*}}{\varepsilon_H} \right) \frac{\varepsilon_H}{n\varepsilon_h}}_{\text{terms-of-trade effect}} \right]^{-1},$$

where $\frac{\varepsilon_H}{n\varepsilon_h} \in (0, 1)$.

The incentive to set a higher nominal wage, $w(u)$, relies on the weighted combination of three effects.

First, since other unions' wages are taken as given, the u -th union perceives its wage as increasing relative to other unions' wages. At the same time, wage hikes boost the cost of labor, inducing firms to substitute labor types $j \in u$ for other labor types $j \notin u$. This effect clearly depends on σ and is captured by the first term in equation (19). Drawing on Lippi's (2003) terminology, it is labeled "substitution effect." Notice that when the direct impact of $w(u)$ on w is less than one (namely when $n > 1$), unions exploit their monopolistic power over differentiated labor services through the elasticity of substitution σ . In the extreme case of a single all-encompassing union ($n = 1$), ε_h is equal to ε_H , so that the real labor demand η is void of any substitution effect. A wage rise, in this case, leads to a proportional increase in aggregate wages without any possibility for the union of increasing its relative wage.

Second, the representative union anticipates that its wage demand causes a reduction in employment through the elasticity of aggregate labor demand with respect to the real wage rate paid by employers (measured in units of each country's aggregate output). This effect is captured by the second term in equation (19) and labeled "output effect" as in Lippi (2003).

In a closed economy, the producer price index coincides with the consumer price index. Therefore, Lippi's analysis (2003) focuses on these two strategic effects only. In this model, η is formed by the output and substitution effect, but also by a third effect which I label "terms-of-trade effect." This component is present as long as the Home employment elasticity to Home wages (ε_H) is different from the Foreign employment elasticity to Home wages (ε_{H^*}). Intuitively, each domestic union has an incentive to boost inflation so as to improve the terms of trade which, in turn, raise the real wage of Home workers relative to Foreign workers. Holding Foreign inflation constant, higher relative inflation in the Home country entails an expenditure switching from the domestically produced good to the foreign produced good, but also a production switching from domestic worker to foreign workers. It turns out that the terms-of-trade

effect produces a “beggar-thy-neighbor” welfare spillover, thereby encouraging wage hikes.⁹

However, conservative monetary policy in the Foreign country can dampen such a channel.

Result 2 *The terms-of-trade effect and equilibrium real wage rate are lower, the more conservative is the foreign central bank.*

In order to prove this result, notice that

$$\alpha(1-\gamma)\left(\frac{\varepsilon_H - \varepsilon_{H^*}}{\varepsilon_H}\right) = \alpha(1-\gamma)\left(\frac{k + \beta^*\theta^*(1-\alpha)}{k + \beta^*\theta^{*2}}\right)$$

is decreasing with the degree of Foreign central bank conservatism.

Intuitively, a conservative monetary authority in the Foreign country responds to Home wage hikes by tightening its monetary policy to curb imported inflation. This leads to a depreciation of the Home currency relative to the Foreign currency, and a lower relative inflation in the Home country. Therefore, a conservative monetary policy in the Foreign country has the overall effect of dampening the incentive to engage in strategic use of wage pressures through the terms-of-trade channel.

The domestic conservative monetary policy has been extensively investigated in the literature (e.g. Gnocchi 2009, Coricelli et al. 2006, Cavallari 2004), while *foreign* conservatism has been disregarded by these studies. Korpos (2006) also argues that foreign central bank conservatism has important implications for wage setting, but this argument is centered only on the substitution and output effects.

4.2 Centralization of wage bargaining

This section assesses the real effects of centralized wage-bargaining system.

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

$$(20) \quad \frac{1}{\eta} = \frac{1}{\sigma} \left(1 - \frac{\varepsilon_H}{n\varepsilon_h}\right) + \frac{1}{\eta|_{n=1}} \frac{\varepsilon_H}{n\varepsilon_h},$$

where

$$\eta|_{n=1} \equiv \left[1 - \alpha + \alpha(1-\gamma)\left(\frac{\varepsilon_H - \varepsilon_{H^*}}{\varepsilon_H}\right)\right]^{-1} = \frac{k + \beta^*[1 - \alpha(1-\gamma)]^2}{(1-\alpha)\beta^*[1 - \alpha(1-\gamma)] + k(1-\alpha\gamma)}.$$

Equation (20) is a weighted average measuring the monopolistic distortion in the labor market.

⁹In a first generation of game-theory models *à la* Canzoneri and Henderson (1988), Jensen (1993) highlights that the real exchange rate appreciation drives a wedge between the consumer and producer real wage, thereby inducing unions to be more aggressive in their wage demands.

The weight entering in the labor demand elasticity η^{-1} is given by

$$(21) \quad \frac{\varepsilon_H}{n\varepsilon_h} = \frac{1}{1 - \frac{\sigma(n-1)}{\varepsilon_H}} \in (0, 1).$$

From the above expression it is apparent that n and ε_H have two opposing effects on the weight attached to the elasticity of labor demand to real wage. More specifically, an increase in the number of unions reduces equation (21), while an increase in aggregate labor demand elasticity raises it.

Result 3 *A rise in the number of unions, i.e. a more decentralized wage setting, increases (reduces) welfare and reduces (increases) inflation if $\sigma > \eta|_{n=1}$ ($\sigma < \eta|_{n=1}$).*

The intuition for this result stems directly from equation (20). Since $1/\eta$ is a linear combination of $1/\sigma$ and $1/\eta|_{n=1}$, an increase in n puts more weight on the substitution effect operating in the labor demand elasticity, so that equilibrium employment rises and inflation diminishes only if $\sigma > \eta|_{n=1}$. The opposite case occurs when $\sigma < \eta|_{n=1}$.¹⁰ Furthermore, since employment is inefficiently low, an increase in labor demand elasticity is accompanied by an increase in welfare as well. It follows that welfare gains hinge on complementarity between labor market distortions and centralization of wage setting. More specifically, labor markets featuring sizeable monopolistic distortions (small σ) call for centralized wage bargaining. Conversely, when monopolistic distortions are low (large σ), a decentralized wage-bargaining system performs better.

This result differs from Coricelli et al. (2004). In their work a rise in the number of unions always worsens Home economic performance. This is due to the different location of the substitution effect assumed. While in this paper the substitution stems from different types of labor inputs needed to produce a single output in each country, in Coricelli et al. (2004) the substitution between different kinds of labor is a consequence of substitutability between the demands for the differentiated goods produced by each type of labor in each country.

It is worth noticing that Result 3 qualifies Lippi's conclusions. With $1 < n < \infty$, Lippi (2003) spells out how in a closed economy both the elasticity of substitution among labor types and the elasticity of aggregate labor demand to nominal wages affect η . Here, a domestic union also internalizes the impact on the terms of trade. It turns out that not only substitution and output effects affect welfare; the terms-of-trade effect also accounts for unions' wage demands in an open economy.

¹⁰Notice that for given values of σ and $\eta|_{n=1}$, Result 3 entails a monotonic relation between the degree of centralization in wage setting and economic performance. This is in contrast with the U-shaped curve *à la* Calmfors and Driffill (1988). The main reason for the absence of a Calmfors-Driffill curve is that the model features a constant elasticity of substitution between labor types (see Guzzo and Velasco 1999).

4.3 Central bank conservatism

How does domestic monetary conservatism affect welfare?

Result 4 *As long as $n \in (1, \infty)$, an increase in central bank conservatism β raises (reduces) welfare if $\sigma < \eta|_{n=1}$ ($\sigma > \eta|_{n=1}$).*

Conservative monetary policy implies that the central bank accommodates wage hikes to a lesser extent, thereby leading to higher (in absolute value) aggregate labor demand elasticities ε_H . This increases the weight attached to the component $1/\eta|_{n=1}$ in (20). As a consequence, if $\sigma < \eta|_{n=1}$, a more conservative central bank is beneficial in terms of welfare because it reduces labor market distortions. Conversely, if $(\sigma > \eta|_{n=1})$, society would be better off with a less conservative central bank.

Result 4 is in contrast with the findings of Jensen (1993) and Coricelli et al. (2004) that a more conservative central bank always boosts employment. This result hinges on the fact that the production function in Jensen does not exhibit any substitution effect, while in Coricelli, Cukierman, and Dalmazzo the substitution between different kinds of labor only stems from the substitutability between the demands for the differentiated goods produced by each type of labor in each country.

5 Concluding remarks

The paper studies conservative monetary policies in an open economy with non-atomistic wage setters. As in Lippi (2003), I find that monetary conservatism can yield real equilibrium outcomes. However, this result hinges on a further strategic channel: the labor union's incentive—through wage claims—to engage in strategic use of the terms of trade.

Installing a foreign conservative central bank dampens this incentive, thereby raising welfare gains. The welfare effects of domestic conservatism, instead, are contingent on the relative size of three strategic effects. When the output and terms-of-trade effects dominate the substitution effect, it is optimal to appoint a more conservative monetary authority. Therefore, Lippi's conclusions, according to which conservative monetary policy and centralized wage setting affect equilibrium employment only through the output and substitution effects, are qualified to allow for the terms-of-trade effect.

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