

Collective Bargaining Regimes and International Monetary Policy*

Vincenzo Cuciniello

Bank of Italy[†]

(Preliminary)

October 3, 2010

Abstract

This paper shows that the overall impact of changes in money supply depends on the degree of collective wage bargaining. It unpacks the international strategic interaction between monetary authorities in a simple micro-founded general equilibrium model with non-atomistic wage setting and nominal rigidities. The strategic incentive of wage setters' to move relative prices affects the welfare transmission of monetary policies. Large unions anticipate that wage hikes raise real interest rate and improve the terms of trade. These two effects reallocate consumption, respectively, from the short run to the long run and from home to foreign types of goods so that the loss in domestic output is more than offset by the gain in domestic consumers' purchasing power. It turns out that the monetary authority incentive to move the terms of trade are abridged in presence of large wage setters and so non-cooperative towards cooperative solutions.

Keywords: Open-economy macro, non-atomistic wage setting, macroeconomic interdependence

JEL: E42, F41, J5

1 Introduction

New Open Economy Macroeconomics (NOEM) models, as pioneered by Obstfeld and Rogoff (1995) and exploited for optimal monetary policy analysis by Corsetti and Pesenti (2001, 2005) (henceforth CP), have emphasized that optimal monetary policy in an open economy may be influenced by the presence of a “terms-of-trade externality.”

Hinging on atomistic agents, NOEM literature disregards potential strategic interactions due to the presence of non-atomistic wage setters (NAWS). Yet, labor market institutions, such as collective bargaining coverage

*I am grateful to Martina Cecioni and seminar participants at the Bank of Italy for comments on an earlier version of this paper. The views expressed herein are those of the author and do not necessarily reflect those of the Bank of Italy. The usual disclaimer applies.

[†]Bank of Italy, Territorial Economic Research Unit, via Dante 3, 16121 Genoa (Italy). Tel.: +39 010 54 91 246; fax: +39 010 54 91 319. *E-mail address:* vincenzo.cuciniello@bancaditalia.it.

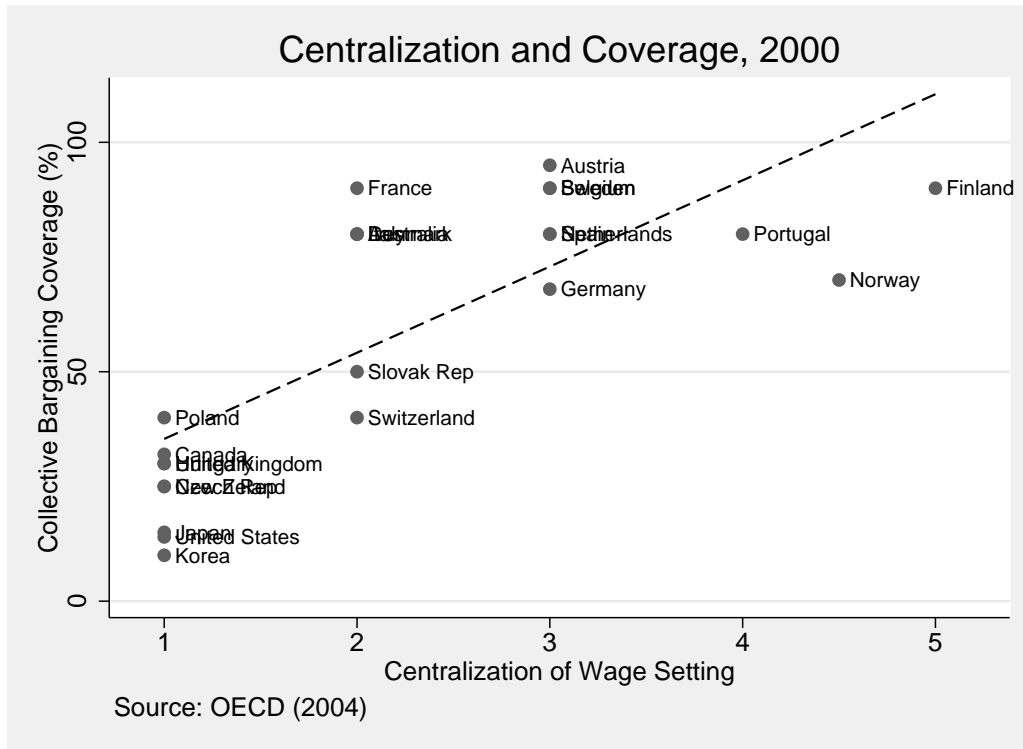


Figure 1: Centralization of Wage Setting and the Coverage of Workers by Collective Bargaining Provisions in OECD countries for the period 2000. 1 = Company and plant level predominant; 2 = Combination of industry and company/plant level; 3 = Industry-level predominant; 4 = Predominantly industrial bargaining, but also recurrent central-level agreements; 5 = Central-level agreements of overriding importance.

and centralization of wage setting, show a considerable variation across countries (see e.g. International Labour Office, 2008; Nickell, Nunziata, and Ochel, 2005). Figure 1 indicates that collective agreements are commonly a distinctive feature of more centralized wage bargaining systems.¹ For example, in most Western European countries negotiations are delegated to few large unions, whose decisions affect the aggregate wages at national or sectoral level. In this context, wage setters can take into account not only the impact of their wage claims on real cost of labor but also on domestic inflation. Labor unions may hence behave strategically with respect to the economy’s relative prices.

The paper contributes to the literature by nesting in a NOEM model both cases of atomistic and NAWS, the latter being previously studied mostly in closed economy.² Specifically, this paper introduces an open economy dimension in a fully laid-out micro-founded model where large labor union internalize the real interest rate and the terms-of-trade effect associated with their wage choice. The model is adapted from CP. It features imperfect competition in the labor market and nominal rigidities in wage setting. But unlike the model in CP,

¹ See OECD (2004) for a survey on the role of union density, union coverage, and wage-setting centralization in OECD countries.
² A few exceptions analyzing non-atomistic wage setting in an open economy setup are: Cavallari (2001), Holden (2003) and Vartiainen (2002) in a small open framework; Jensen (1993) in a two-country model *à la* Canzoneri and Henderson (1988); Soskice and Iversen (1998), Cukierman and Lippi (2001) and Coricelli, Cukierman, and Dalmazzo (2004) in a monetary union. This literature, however, is based on models without explicit intertemporal microfoundations.

monopolistic power in the labor market is now delegated to non-atomistic agents so as to capture the positive relationship (plotted in Figure 1) between centralization of wage setting and collective bargaining coverage.

I show that centralized labor markets improve the ability of wage setters to internalize the repercussion of wage claims on real interest rate and terms-of-trade and, hence, on aggregate employment.³ In particular, labor unions perceive their wage claims as improving the terms of trade and raising the real interest rate. Intuitively, domestic NAWS anticipate that an increase in their nominal wages boosts domestic producer prices, since the higher labor costs faced by the domestic producers cause them to raise their prices. This yields two effects on relative prices that, in turn, abridge domestic aggregate employment. First, real interest rate rises. Domestic households then switch consumption from the short run to the long run. Such a channel is captured by the *intertemporal* elasticity of substitution in consumption and operates both in closed and open economy. Second, the terms of trade improve in the wake of higher domestic inflation. Domestic households therefore switch their consumption towards the foreign good in the short run. This mechanism, instead, is typical of an open economy and is captured by the elasticity of *intra-temporal* substitution in consumption.

In contrast to the atomistic case, intertemporal and intra-temporal substitution constitute a “strategic” component of the labor demand elasticity to real wages. Large union can consequently exploit a certain degree of monopoly power through these two channels. The higher is the rate of collective wage bargaining, the more intertemporal and intra-temporal elasticities are relevant in the wage-decision process. It turns out that collective wage bargaining might be welfare improving in an open economy because of the “terms-of-trade externality.” A wage claim in fact reduces output apart from its efficient level. But in open economies a wage hike also increases domestic consumers’ purchasing power internationally. Because of the latter effect, monopolistic wage setting can raise welfare.

The paper’s main results can be summarized as follows. First, the presence of NAWS reduces the incentive of the policy makers to affect the terms of trade. As outlined above, the strategic use of the terms of trade is perceived as welfare improving, and it is at the root of wage claims by NAWS. This in fact yields a reduction in utility stemming from the decrease in consumption that less than offset the reduction in the disutility of producing goods, since the burden of production is shifted to the other country. It follows that the traditional monetary policy contraction bias is reduced simply because the trade-off between the reduction in structural distortion (due to the monopolistic factor market) and the incentive to raise the strategic distortion (given by the terms of trade) is now internalized by NAWS. In the extreme case of a single all-encompassing wage setter, the monetary authority has no incentive to improve the terms of trade and the resulting allocation is efficient

³Summers, Gruber, and Vergara (1993) studies the role of centralized labor markets on labor taxes. Their findings are that non-atomistic wage setters internalize the linkage between the taxes that workers pay and the benefits associated with them so that taxes on labor input are less distortionary than in presence of atomistic wage setters.

also under a non cooperative monetary regime. Thus, not only by cooperating the two monetary authorities can eliminate the distortions of the terms of trade. Second, this incentive is smaller, the higher are the degrees of centralization of wage setting and the degrees of openness. Third, in line with CP, a monetary expansion is *beggar-thyself* when the degree of substitutability across labor types is larger than the weighted combination of intertemporal and intratemporal elasticities; while it is welfare improving when labor market distortions are sizeable, namely a relatively small elasticity of substitution across labor types.

Early contributions on strategic interaction between monetary policy and NAWS, such as Bratsiotis and Martin (1999), Soskice and Iversen (2000) and Lippi (2003), have shown that central bank preferences affect the perceived elasticity of aggregate demand to wages, thereby making labor unions more sensitive to monetary policy.⁴ In particular, an inflation-averse (“conservative”) monetary authority has an impact on labor supply decision and, consequently, on long-run employment. With a different perspective, this paper does not assume any direct strategic interaction between unions and monetary authority. It extends the framework previously used by CP and performs welfare analysis in the same vein. In this context, welfare analysis allows to inspect how policy makers’ incentives differ from the atomistic wage setters case. In doing so, I bridge the gap between the strands of NOEM and NAWS literature. Specifically, the model contributes to the NOEM literature by adding strategic elements into the labor market and to the NAWS literature by adding explicit intertemporal micro-foundation in an open economy framework.⁵

The paper is organized as follows. The following section describes the model economy. Equilibrium outcomes under non-atomistic wage setting are derived in Section 3. The welfare effects of monetary policy are analysed in Section 4. This is followed by concluding remarks.

2 The model

The model is adapted from CP. I consider a world economy formed by two countries, home and foreign, each specialized in the production of a single traded good.⁶ Each country is populated by a continuum of identical households with size normalized to 1. The household’s preferences are similar across countries, so I focus on the representative household j in the home country. As usual, foreign variable will be denoted by “*”.

⁴Many other studies analyze the role of central bank preferences in presence of non-atomistic wage setters. For a non-exhaustive list of works investigating the long-run effect of central bank conservatism on collective and centralized wage bargaining, see, for example, Skott (1997), Cubitt (1992), Guzzo and Velasco (1999), Acocella and Di Bartolomeo (2004), Cukierman and Lippi (1999), Coricelli, Cukierman, and Dalmazzo (2006), Lawler (2000) and Gnocchi (2009).

⁵However, the introduction of a conservative central bank would simply amplify the aggregate effects discussed above on NAWS decisions (see Cuciniello, 2009). As aggressive wage policies cause inflation, the tougher is monetary policy in pursuing the objective of price stability, the larger are labor demand reductions in the wake of restrictive monetary policy.

⁶I could have assumed a small open economy framework, but this would not have changed the main results that follows.

2.1 The elements of the CP model

The utility function is given by

$$U_t(j) = \sum_{z=t}^{\infty} \beta^{z-t} \left[\frac{C_z(j)^{1-\rho}}{1-\rho} + \chi \log \frac{M_z(j)}{P_z} - \frac{\kappa}{2} \ell_z(j)^2 \right]. \quad (1)$$

Here $0 < \beta < 1$ is a subjective discount factor, equal to $1/(1 + \delta)$, where $\delta > 0$ is the rate of time preference, C denotes final consumption, $1/\rho$ is the elasticity of intertemporal substitution, ℓ denotes the amount of labor supplied by the household, and M/P is real money holding.

The period-budget constraint facing the j -th household is given by

$$B_{t+1}(j) + M_t(j) \leq (1 + i_t)B_t(j) + M_{t-1}(j) + W_t(j)\ell_t(j) - P_t T_t(j) - P_t C_t, \quad (2)$$

where B is an internationally traded bond denominated in composite consumption units, and its nominal yield (paid at the beginning of period t) is i_t ; T denote lump-sum net taxes, W is the nominal wage rate, and C is a Cobb-Douglas consumption index for the home household defined as

$$C_t(j) \equiv C_{H,t}(j)^\gamma C_{F,t}(j)^{1-\gamma}, \quad 0 < \gamma < 1, \quad (3)$$

where $C_{H,t}(j)$ and $C_{F,t}(j)$ are respectively domestic consumption of the home and foreign goods by household j . The consumption-based price index P is given by

$$P_t \equiv \frac{1}{\gamma_W} P_{H,t}^\gamma (\mathcal{E}_t P_{F,t}^*)^{1-\gamma}, \quad \gamma_W \equiv \gamma^\gamma (1-\gamma)^{1-\gamma}, \quad (4)$$

where P_H and P_F^* are respectively the prices of home good in domestic currency and of foreign good in foreign in foreign currency. \mathcal{E} is the nominal exchange rate expressed in domestic currency per unit of foreign currency. Foreign households are modeled in an analogous way.

Bonds traded internationally are in zero net supply

$$\int_0^1 B_t(j) dj + \int_0^1 B_t^*(j^*) dj^* = 0. \quad (5)$$

I abstract from government spending and assume that in each country the seigniorage income is repaid to domestic households through a lump-sum transfer

$$-P_t \int_0^1 T_t(j) dj = M_t - M_{t-1}, \quad (6)$$

where $M_t = \int_0^1 M_t(j) dj$.

Perfectly competitive firms hire a continuum of differentiated labor inputs to produce output according to the production function⁷

$$Y_t = \left(\int_0^1 \ell_t(j)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1 \quad (7)$$

where Y denotes output per capita in the home country and the parameter σ is the elasticity of substitution across labor types. The worldwide resource constraints for the home good is

$$Y_t \geq \int_0^1 C_{H,t}(j) dj + \int_0^1 C_{H,t}^*(j^*) dj^* \quad (8)$$

As firms are price-takers both domestically and abroad, the law of one price holds:

$$P_{F,t} = P_{F,t}^* \mathcal{E}_t, \quad P_{H,t}^* = P_{H,t} / \mathcal{E}_t. \quad (9)$$

For a given level of production, the demand for labor type j by each firm is given by

$$\ell_t(j) = \left(\frac{W_t(j)}{W_t} \right)^{-\sigma} Y_t, \quad (10)$$

where $W(j)$ denotes the nominal wage of labor type j supplied by domestic household j , and W is the nominal wage index defined as

$$W_t = \left(\int_0^1 W_t(j)^{1-\sigma} dj \right)^{\frac{1}{1-\sigma}}. \quad (11)$$

From the firms optimal conditions, nominal wages are equal to product prices, i.e. $P_H = W$ and $P_F^* = W^*$, so that the terms of trade can be defined as follows:

$$\mathcal{T} = \frac{\mathcal{E} P_F^*}{P_H} = \frac{\mathcal{E} W^*}{W}. \quad (12)$$

2.2 The CP model in its structural form

I assume that the economy is initially at a symmetric steady state (variables indexed by the subscript 0) in which neither country is a net debtor. At period t an unforeseen permanent monetary shock occurs and information about future shocks is revealed (perfect foresight equilibrium). From period t to $t+1$, i.e. the short run, I allow for nominal rigidities in wages. Short-run variables are not indexed at all. Next, at period $t+1$, i.e. the long run, prices and wages fully adjust. From then on the economy is in a long-run steady state, with variables denoted

⁷Monopolistic competition in the product market would not qualitatively alter the main results of the paper.

by an upper bar. Note that monetary shocks are permanent, i.e. $M = \bar{M}$.

To facilitate analysis of optimal wage setting, I first describe the CP structural-form model in Table 1 and 2, and then turn to the equilibrium condition referring to the optimal trade-off between labor and leisure. The Euler equations are (13) and (20), where r is the short-run real interest rate, namely the rate of return on an international bond indexed to the composite consumption good. In the short run, equilibrium in the money markets requires (14) and (21), where the nominal interest rate $1 + i$ is defined as the product of the real return on the bond $1 + r$ and the CPI inflation rate \bar{P}/P . In the long run, the money market equilibrium conditions are given by (15) and (22), where the long-run interest rate in both countries is equal to the rate of time preference δ . Due to the assumption that neither country is a net lender in the initial equilibrium, i.e. $B_0 = B_0^*/\mathcal{E}_0 = 0$, eqs. (16) and (23) are the short-run current account identities, where B is the net bond position. In the long run, the steady-state consumption level is equal to output plus net interest payments to (or from) the rest of the world (see (17) and (24)). The last eqs. (18) and (19), are the short-run and long-run aggregate equilibrium conditions in the goods markets in the home country. Similarly, eqs. (25) and (26) are the short-run and long-run aggregate equilibrium conditions in the goods markets in the foreign country.

Table 1: Structural form of the model, home country

$C^{-\rho} = \beta(1+r)(\bar{C})^{-\rho}$	Euler equation	(13)
$\frac{\bar{M}}{P} = \chi \frac{1+i}{i} C^\rho$	Short-run money market equilibrium	(14)
$\frac{\bar{M}}{P} = \chi \frac{1+\delta}{\delta} \bar{C}^\rho$	Long-run money market equilibrium	(15)
$B = P_H Y - PC$	Short-run current account	(16)
$\bar{C} = \frac{\bar{P}_H \bar{Y}}{\bar{P}} + \delta \frac{\bar{B}}{\bar{P}}$	Long-run consumption h	(17)
$\frac{P_H Y}{P} = \gamma(C + C^*)$	Short-run goods markets equilibrium	(18)
$\frac{\bar{P}_H \bar{Y}}{\bar{P}} = \gamma(\bar{C} + \bar{C}^*)$	Long-run goods markets equilibrium	(19)

Wages are predetermined (one-period nominal wage contract) but, unlike the model in CP, they are bargained by non-atomistic wage setters. For a given wage, households are willing to supply whatever quantity of labor is required to clear the markets. As the short run coincides with the length of the wage contracts, wages in the short run are set at a level consistent with the initial steady-state equilibrium, namely $W_0 = P_{H_0} = W$ and $W_0^* = P_{F_0}^* = W^*$. The implication of strategic wage setting on labor supply will be discussed in the next section.

Table 2: Structural form of the model, foreign country

$C^{*\rho} = \beta(1+r)(\bar{C}^*)^{-\rho}$	Euler equation	(20)
$\frac{\bar{M}^*}{P^*} = \chi \frac{1+i^*}{i^*} C^{*\rho}$	Short-run money market equilibrium	(21)
$\frac{\bar{M}^*}{P^*} = \chi \frac{1+\delta}{\delta} \bar{C}^{*\rho}$	Long-run money market equilibrium	(22)
$-\frac{B}{\mathcal{E}} = P_F^* Y^* - P^* C^*$	Short-run current account	(23)
$\bar{C}^* = \frac{\bar{P}_F^* \bar{Y}^*}{\bar{P}^*} - \delta \frac{\bar{B}}{\bar{P}^* \mathcal{E}}$	Long-run consumption	(24)
$\frac{P_F^* Y^*}{P^*} = (1-\gamma)(C+C^*)$	Short-run goods markets equilibrium	(25)
$\frac{\bar{P}_F^* \bar{Y}^*}{\bar{P}^*} = (1-\gamma)(\bar{C}+\bar{C}^*)$	Long-run goods markets equilibrium	(26)

3 Wage setters' strategy

In each country households (monopolistic suppliers of productive inputs) are organized in $n > 1$ labor unions. As common in the NAWS literature, I assume that all types of labor are unionized and equally distributed among unions. Therefore $1/n$ indicates both the representative union's mass and the fraction of workers covered by collective agreement, namely the fraction of households whose pay has been negotiated through collective bargaining. This framework captures the fact that more centralized systems, whereby collective agreements are signed at national or sectoral level, typically have a higher coverage of collective bargaining (see Figure 1). As the representative union u has a positive mass, it will anticipate that⁸

$$\frac{\partial W}{\partial W(u)} = \frac{1}{n} \left(\frac{W(u)}{W} \right)^{-\sigma}, \quad (27)$$

i.e. the higher its mass the more the u -th union internalizes the impact of its wage settlement on aggregate wage (see e.g. Soskice and Iversen, 2000; Lippi, 2003). It turns out that unions are large enough to internalize firms' responses to their actions. Specifically, taking the nominal wages of other unions $W(-u)$ as given, each union u realizes that a wage hike creates inflationary pressures via the profit maximizing condition of firms, $P_H = W$, as follows:

$$\left. \frac{\partial P_H}{\partial W(u)} \right|_{W(-u)} = \frac{1}{n}, \quad (28)$$

⁸Eq. (27) is derived in Appendix A and is key to the model results.

where the last equality holds at a symmetric equilibrium. If unions are atomistic ($n \rightarrow \infty$) the impact of wage claims on domestic prices is zero; if unions are non-atomistic, the effect is positive and increasing in bargaining coverage.

Appendix B shows that the elasticity of aggregate labor demand to changes in nominal wage W is

$$\Sigma_Y \equiv -\frac{\partial \log Y}{\partial \log W} = 1 - \gamma + \frac{\gamma}{\rho}. \quad (29)$$

Eq. (29) is a weighted average, with weights (γ) and $(1 - \gamma)$, of a closed and open economy effect. An intuitive account of these two channels through which domestic wage pressures are expected to reduce aggregate labor follows. First, domestic unions perceive that an increase in wages boosts domestic inflation through eq. (28), thereby leading to a higher real interest rate. This effect reduces aggregate employment (output) demand by inducing households to switch consumption from the short run to the long run. The strength of this channel is captured by the *intertemporal* elasticity of substitution in consumption $1/\rho$ in eq. (29). In a closed economy (i.e. when $\gamma = 1$) $1/\rho$ fully describes the elasticity of aggregate employment to wage (see Gnocchi, 2009). Second, in an open economy (i.e. when $\gamma \neq 1$) the reaction of employment (output) to inflationary wage also depends on the reallocation of consumption across different types of goods. Specifically, unions anticipate that an increase in wages leads to an improvement in the terms of trade (see Appendix B). As the domestic good becomes more costly than the foreign one, domestic households switch their consumption towards the foreign good in the short run. It turns out that home employment decreases relative to foreign employment. The strength of this channel is captured by the elasticity of *intra-temporal* substitution in consumption, which is equal to 1 in the CP model.⁹

Notice that, in contrast to the NAWS literature (e.g. Soskice and Iversen, 2000; Lippi, 2003), central bank preferences do not appear in (29). Existing contributions in fact investigate the *anticipated*-permanent real effect on labor supply of a change in the policy rule or targeting rule. In this paper, monetary policy is instead an *unanticipated*-permanent monetary shock that hits the economy. I prefer following the style of CP and try to assess how the incentives of the policy makers are affected by the presence of collective wage bargaining. However, it can be shown that introducing an endogenous monetary policy magnifies the above mechanism, since central bank conservatism would depress aggregate demand to a larger extent.¹⁰

Nominal wages in period t are predetermined with contracts signed at time $t - 1$. Drawing on Lippi (2003),

⁹Clearly the intratemporal mechanism is proportional to the size of demand elasticity for the country products. In the CP model, when $1 > 1/\rho$, the intratemporal effect is larger than the intertemporal one. If $\rho = 1$ the intertemporal substitution in consumption due to a wage claim is equivalent to the intratemporal switching towards foreign goods.

¹⁰Cuciniello (2009) shows how the international dimension of monetary conservatism may add to the conventional closed economy case analyzed by Soskice and Iversen (2000) and Lippi (2003).

each union plays a Nash game with other unions: they simultaneously set nominal wages, taking the other unions' nominal wage as given. In doing that, the u -th labor unions chooses the nominal wage $W(u)$ on behalf of its members maximizing their lifetime utility function (1), disregarding liquidity effects, subject to the budget constraint (2) and labor demand (10) for all members $j \in u$.¹¹ The solution to the union's problem is

$$E_{t-1}[\kappa \ell_t^2(u)] \frac{\phi}{\phi - 1} = W_t(u) E_{t-1} \left[\frac{1}{P_t} \frac{\ell_t(u)}{C_t^\rho} \right], \quad (30)$$

where $\phi \equiv \frac{\Sigma_\ell}{1 - \Sigma_P} > 1$ is the elasticity of labor demand to real wage perceived by the u -th union for each of its members:

$$\Sigma_\ell \equiv - \frac{\partial \log \ell(u)}{\partial \log W(u)} = \sigma \left(1 - \frac{1}{n} \right) - \frac{\partial \log Y}{\partial \log W} \frac{1}{n} = \sigma \left(1 - \frac{1}{n} \right) + \Sigma_Y \frac{1}{n}, \quad (31)$$

$$\Sigma_P \equiv \frac{\partial \log P}{\partial \log W(u)} = \frac{\partial \log(W \mathcal{T}^{1-\gamma}/\gamma W)}{\partial \log W(u)} = \frac{\gamma}{n}. \quad (32)$$

Eq. (31) defines the elasticity of domestic labor demand as a weighted average (with weights respectively $1 - 1/n$ and $1/n$) of the elasticity of substitution across labor types σ and of the elasticity of domestic aggregate labor demand (29).¹² It nests the standard case of a labor demand elasticity equal to σ as a special case (i.e. atomistic wage setters, $n \rightarrow \infty$). With large unions, instead, the mark-up $\phi/(\phi - 1)$ depends on the response of aggregate employment to wage as assessed above.

It is worth noticing that the wage mark-up is higher, and therefore labor market distortion larger, the greater is the degree of openness. Intuitively, unions perceive to control real wage to a larger extent in an open economy. In fact, the impact of a wage hike on the CPI is decreasing in γ ; as long as γ is different from zero, unions perceive real wage as increasing less than one-to-one with nominal wage. Non-atomistic unions anticipate this and restrain their wage demands.

4 The impact of domestic monetary shocks

I define world variables as $X_W = (X)^{\gamma}(X^*)^{1-\gamma}$, while relative variables are defined as $X_R = X/X^*$. The model is solved considering a symmetric steady state (variables indexed by the subscript 0) in which no country has any net claims on the other: $B = B^* = 0$; the interest rate reflects the discount factor: $i_0 = \beta^{-1} - 1$. All households worldwide are identical and consume and produce an amount C_0 .

¹¹The benevolent union hypothesis is consistent with the traditional labor union theory (e.g. Oswald, 1985). Notice that the monopolistic union hypothesis can be considered as a limiting case of a right-to-manage model, where workers have all the bargaining power.

¹²This result is in contrast with the U-shaped relation predicted in Calmfors and Driffill (1988) between centralization of wage bargaining and economic performance, which in this case depends on the union's mark-up. The main reason is that the competition level in this model is not proportional to the degree of decentralization of wage bargaining as in Calmfors and Driffill (1988). See Guzzo and Velasco (1999) for a discussion of this issue.

I assume that the economy is initially at the symmetric steady state. At time t , it is affected by a permanent monetary shock. The economy is characterized by nominal rigidities. Wages are set for period t (the short run), and can be adjusted only at period $t + 1$. From period $t + 1$ on, the economy is in a new steady state I refer to as the long run. The long-run values are denoted by an upper bar, while the short-run values are plain variables.

Table 3: Solution of the model, home country^a

$C = \bar{C}(\bar{M}_W/M_{W_0})^{1/\rho}$	Short-run consumption
$Y = \bar{Y}(\bar{M}_R/M_{R_0})^{1-\gamma}(\bar{M}_W/M_{W_0})^{1/\rho}$	Short-run output
$\bar{M}/P = (\bar{M}/\bar{P})(\bar{M}_W/M_{W_0})$	Short-run real balances
$\mathcal{T} = \bar{\mathcal{T}}\bar{M}_R/M_{R_0}$	Short-run terms of trade
$1 + r = \beta^{-1}(\bar{M}_W/M_{W_0})^{-1}$	Short-run real interest rate
$\bar{C} = a_1$	Long-run consumption
$\bar{\mathcal{T}} = a_2$	Long-run terms of trade
$\bar{Y} = a_3$	Long-run output
$\bar{M}/\bar{P} = a_4$	Long-run real balances
$\bar{\mathcal{E}} = \bar{\mathcal{E}} = a_5\bar{M}_R$	Nominal exchange rate

^aThe constants are defined below, where the subscript 0 denotes pre-shock levels, and $\Phi \equiv (\phi - 1)/(\phi \kappa)$. $a_1 \equiv \Phi_R^{(\gamma-1)/(1+\rho)}[\gamma/(1-\gamma)]^{1-\gamma}\gamma_W^{2/(1+\rho)}\Phi^{1/(1+\rho)}$; $a_2 \equiv \Phi_R^{1/2}[(1-\gamma)/\gamma]^{(1+\rho)/2}$; $a_3 \equiv \Phi_R^{(1-\gamma)(\rho-1)/(2(1+\rho))}\Phi^{1/(1+\rho)}[\gamma/(1-\gamma)]^{(1-\gamma)(1-\rho)/2}\gamma_W^{(1-\rho)/(1+\rho)}$; $a_4 \equiv \chi(1+\delta)/\delta\Phi_R^{\rho(\gamma-1)/(1+\rho)}[\gamma/(1-\gamma)]^{(1-\gamma)\rho}\gamma_W^{2\rho/(1+\rho)}\Phi^{\rho/(1+\rho)}$; $a_5 \equiv [(1-\gamma)/\gamma]^\rho$.

Table 3 illustrates the closed-form solution of the model for the home country. Notice that the key difference with the CP model resides in the labor union markup $\phi/(\phi - 1) > 1$. As in the short run monetary policy can affect the equilibrium allocation, while is neutral in the long run, welfare analysis will be based on the lifetime utility of the home representative agent in the short run as follows:

$$U = \frac{C^{1-\rho}}{1-\rho} + \chi \log \frac{\bar{M}}{P} - \frac{\kappa}{2} Y^2. \quad (33)$$

In the CP model a monetary authority has an incentive to contract its money supply. A tightening policy in fact reduces in the same proportion consumption and output. However, output is further reduced by the improvement in the terms of trade. It turns out that the reduction in the utility derived from consumption is more than compensated by the reduction in the disutility of providing labor service.

When is a monetary expansion *beggar-thyself*?

In order to address this question, I abstract from the direct welfare impact of real balances (i.e. $\chi \rightarrow 0$) and focus on consumption and effort as in CP. Thus, differentiating (33) with respect to \bar{M} yields

$$\frac{\partial U}{\partial \bar{M}} = \frac{\gamma}{\rho \bar{M}} \left[C^{1-\rho} - \kappa Y^2 \left(1 + \rho \frac{1-\gamma}{\gamma} \right) \right]. \quad (34)$$

The marginal effect of deviating from the initial steady state is assessed by evaluating (34) at $\bar{M} = M_0$ as follows:

$$\text{sign} \left(\frac{\partial U}{\partial \bar{M}} \right) \Big|_{\bar{M}=M_0} = \text{sign} [1 - D], \quad (35)$$

where D has been defined as

$$D \equiv \frac{\phi - 1}{\phi} \left(1 + \rho \frac{1-\gamma}{\gamma} \right) = \left(1 + \frac{(n-\gamma)\rho}{\gamma + (n-1)\rho(\sigma-1)} \right)^{-1} \left(1 + \rho \frac{1-\gamma}{\gamma} \right). \quad (36)$$

Similarly, the marginal effect of deviating from the initial steady state in the foreign country is given by:

$$\text{sign} \left(\frac{\partial U^*}{\partial \bar{M}^*} \right) \Big|_{\bar{M}^*=M_0^*} = \text{sign} [1 - D^*], \quad (37)$$

where D^* has been defined as

$$D^* \equiv \frac{\phi^* - 1}{\phi^*} \left(1 + \rho \frac{\gamma}{1-\gamma} \right) = \left(1 + \frac{(n^* - (1-\gamma))\rho}{1-\gamma + (n^*-1)\rho(\sigma-1)} \right)^{-1} \left(1 + \rho \frac{\gamma}{1-\gamma} \right). \quad (38)$$

A key point is that collective bargaining regimes and monopolistic distortions matter for the dimension of D and, hence, for the sign (35). Specifically, (35) is positive when labor market distortions are larger than the intratemporal and intertemporal effects analyzed in Section 3, i.e. when $\sigma < 1 + \gamma/[\rho(1-\gamma)]$. Conversely, it is negative when monopolistic distortion in the input markets are relatively less relevant, i.e. when $\sigma > 1 + \gamma/[\rho(1-\gamma)]$. Whether monopolistic distortions are substantial, real wages are excessively high. It turns out that a small monetary shock improves welfare by reducing real wages and raising output and employment. In other words, a higher level of domestic consumption dominates the disutility of the additional work effort. Conversely, when labor market distortions are low, the negative terms of trade externality may more than offset this positive aggregate demand externality. As stressed in Tille (2001), a monetary expansion worsens the terms of trade leading to a shift of world consumption towards home goods. The residents of the home country benefit from a larger revenue generated by additional export revenue that can be used to purchase

more imports and increase consumption. However, producing the output requires a costly effort. When σ is high, i.e. $\sigma > 1 + \gamma/[\rho(1 - \gamma)]$, the economy already operates close to the competitive equilibrium where real wages are equal to the marginal rate of substitution between consumption and leisure; therefore the benefit from reducing the small monopolistic distortion through an increase in output is small. In this case, there is a *beggar-thyself* effect because the output expansion requires such a large worsening of the terms of trade that it does not generate enough revenue to compensate for the cost of effort.

How are the monetary authority incentives affected by the presence of collective wage bargaining?

The second mechanism that affects D is the degree of collective wage bargaining captured by $1/n$. As described in Section 3, the strategic effect of a wage hike is reinforced by the unions' capacity for internalizing the impact of their wage demands on domestic prices: the higher the degree of collective bargaining coverage ($1/n$), the more labor unions perceive their wage claims as improving the terms of trade. This switches domestic consumption towards the foreign good as well as reducing domestic employment. The welfare effect is therefore *beggar-thy-neighbor*.

Figure 2 shows utility levels associated with monetary stance. The monetary authority's incentive (in its space of strategy) to deviate from the initial steady state M_0 depends on the impact of M on utility. It is apparent that this incentive is larger when the rate of bargaining coverage is low (dashed line), while it is lower the higher the coverage of collective bargaining, i.e. when n is small. In the extreme case of a single all encompassing union $n = 1$ (solid line), expression (36) shows that the negative terms of trade externality induced by a monetary expansion is exactly offset by the positive aggregate demand externality which decreases real wages. Real wage mark-up, in this case, reflects the union's monopolistic power stemming from the intratemporal and intertemporal effects

$$\left. \frac{\phi}{\phi - 1} \right|_{n=1} = 1 + \left(\frac{1 - \gamma}{\gamma} \right) \rho.$$

Intuitively, national-level collective bargaining entails real wages as fully internalizing the terms of trade externality, thereby being already high enough to eliminate any monetary incentive to improve the terms of trade. Formally, the effect of a small monetary shock from the initial steady state on domestic welfare is null, namely the sign (35) is zero.

Moreover, it is worth noticing that an increase in degree of centralization in wage bargaining (higher $1/n$) does not necessarily lead to an increase in unions' markup. In particular, when monopoly distortions are relatively high, i.e. $\sigma < 1 + \gamma/[\rho(1 - \gamma)]$, a more centralized wage setting reduces the union's markup $\phi/(\phi - 1)$; conversely, when monopoly distortions are relatively weak, i.e. $\sigma > 1 + \gamma/[\rho(1 - \gamma)]$, a more centralized

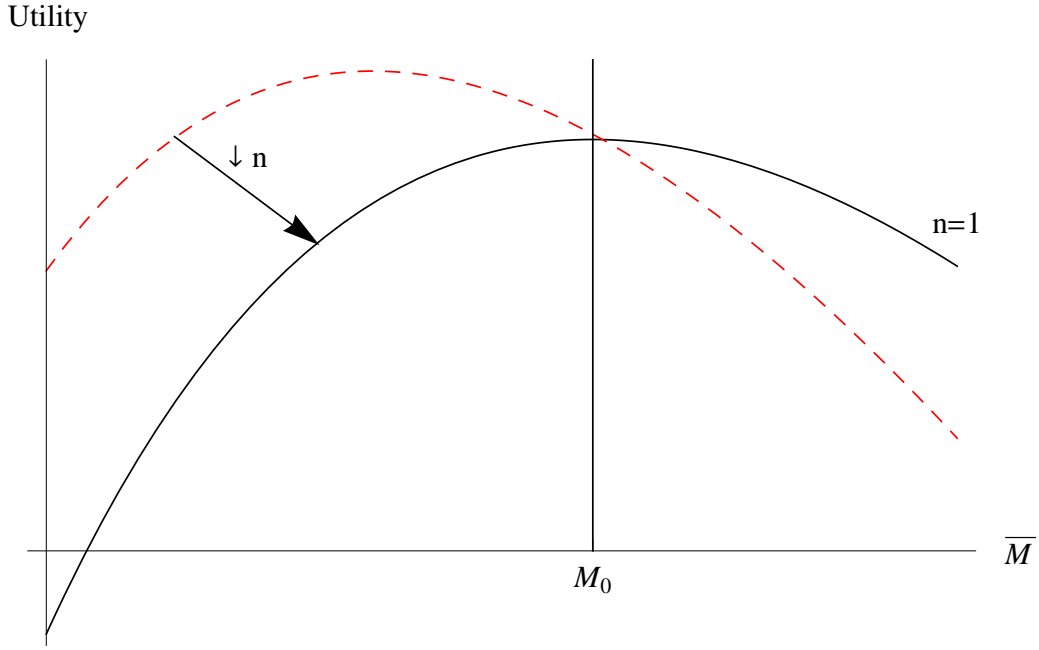


Figure 2: Monetary incentive to deviate from the initial steady state

wage setting raises the union's markup $\phi/(\phi - 1)$. This result is due to the fact that the labor demand elasticity ϕ is a weighted combination of σ and $1 + \gamma/[\rho(1 - \gamma)]$ with weights respectively $1 - 1/n$ and $1/n$.

Thus, determining the sign of the welfare effect of centralized labor market not only requires information on the likely size of the labor substitution elasticity (σ) and on the strategic aggregate term ($1 + \gamma/[\rho(1 - \gamma)]$), but also on the collective bargaining regime ($1/n$). In the New-Keynesian literature—and as noted, among others, by Erceg, Henderson, and Levin (2000)—labor market institutions do affect the monetary policy transmission mechanism creating a tension between inflation and output gap stabilization through nominal rigidities (i.e. dynamic distortion). This distinguishes my analysis from that of standard New-Keynesian models (e.g Benigno and Benigno, 2003) that assume the monetary authority would have an incentive to deviate from the flexible price equilibrium allocation to improve the terms of trade (i.e. static distortion) disregarding the interplay of labor market institutions and monetary policy.

5 Non cooperative and cooperative solution to monetary interdependence

I start assessing the interaction between the home and foreign country in the non cooperative Nash equilibrium. The unanticipated money innovation in the non cooperative case is obtained by solving (34) and using the reduced form of Table 3 as follows:

$$\bar{M}_R^N = M_{R_0} D_R^{-1/2}, \quad (39)$$

where D and D^* are respectively defined in (36) and (38). It turns out that the exchange rate and terms of trade—which are proportional to (39)—are functions of the monopolistic distortion in the labor market as well as the possibility of influencing the terms of trade in a way beneficial to domestic consumers. As shown by Corsetti and Pesenti (2001) and Benigno (2002), in a Nash equilibrium both economies are operating under monopolistic competition, namely the policymakers contract their policies too much. The resulting level of output is hence below the efficient one $1 = kC^{\rho-1}Y^2$ which equates the real wage and the marginal cost of labor in term of utility.

Plugging (39) into (34) yields the equilibrium level of money in the global economy

$$\bar{M}_W^N = M_{W_0} D_W^{-\rho/(1+\rho)}. \quad (40)$$

It is possible to show that in the Nash equilibrium both countries do not internalize the positive externalities given by a coordinated expansion (see Benigno, 2002). Moreover, as long as both countries maintain monopolistic power, there exists an allocation that constitutes a Pareto improvement. The optimal relative money innovation that yields such a result under a cooperative agreement¹³

$$\bar{M}_R^C = M_{R_0} \left[\left(\frac{1-\phi}{\phi} \right) / \left(\frac{1-\phi^*}{\phi^*} \right) \right]^{-1/2}, \quad (41)$$

which is evidently independent of the “open-economy distortion” stemming from the incentive to improve the terms of trade. The optimal global money expansion is

$$\bar{M}_W^C = M_{W_0} \left[\left(\frac{1-\phi}{\phi} \right)^\gamma \left(\frac{1-\phi^*}{\phi^*} \right)^{1-\gamma} \right]^{-\rho/(1+\rho)}. \quad (42)$$

Notice that the terms of trade under the two solution coincides when $\gamma = 1/2$, otherwise in the Nash equilibrium it is proportional to γ (the size of the home country) for any ρ . In other words, the larger is the home country, the more terms of trade in such a country will be depreciated. As to the global money expansion, it is always larger under cooperation than in the non cooperative solution. This result is familiar with the Keynesian literature on international policy coordination (see Rogoff, 1985).

Relying on a graphical simulation of M^N and M^C , optimal monetary policy is indeed related to the size of unions. In a baseline calibration (i.e. $\rho = 4$, $\sigma = 11$, $M_0 = 1$ and $\gamma = 0.8$), Figure 3 illustrates that cooperation may remove the disincentive to inflate as in Rogoff (1985). The figure displays the percentage points optimal monetary policy in a cooperative regime associated with intermediate degrees of collective wage bargaining

¹³The cooperative solution is defined as an equilibrium where both countries agree on a fixed terms of trade. Each country determines simultaneously its money supply taking the relative prices as given.

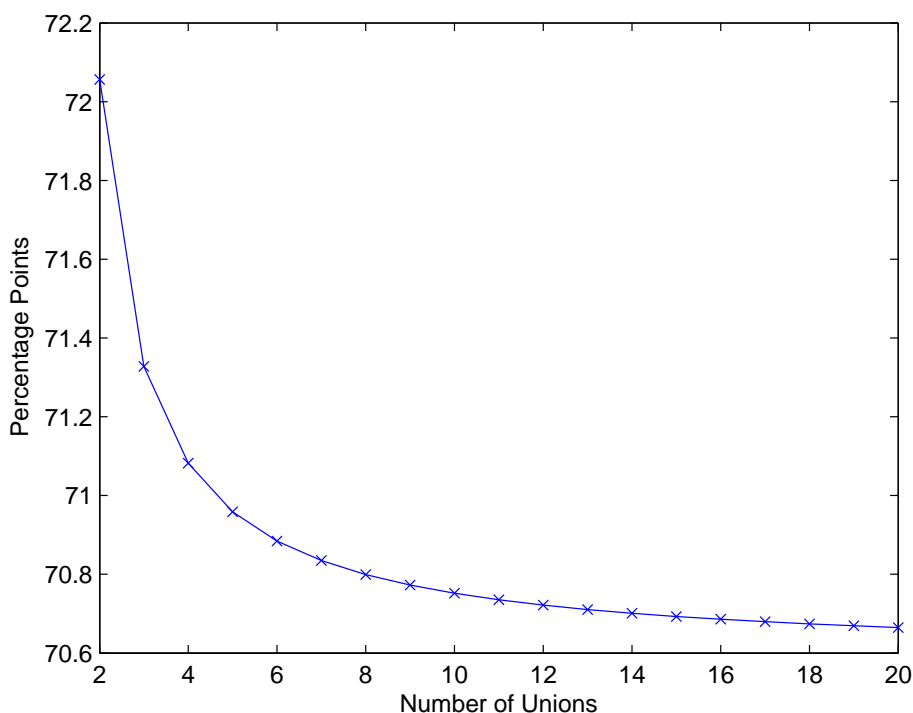


Figure 3: Optimal Cooperative Relative to Non Cooperative Monetary Policy

relative to the non cooperative case. The more centralized is wage setting, the more expansive will be monetary policy so as to eliminate the monopolistic distortion which, under this parametrization, is increasing in unions' size. Although small in absolute terms, these values are comparable to that associated with suboptimal stabilization policies in the literature. Therefore it suggests that models abstracting from the presence of large wage setters in an open economy may overlook a relevant aspect for designing optimal monetary policy.

6 Concluding remarks

This paper extends the framework previously used by Corsetti and Pesenti (2001) to allow for the presence of Non-atomistic Wage Setters (NAWS). In particular, it addresses the following questions: i) how are the incentives of the policy makers affected by the presence of collective wage bargaining?; ii) how is this influenced by the presence of large wage setters?; iii) when is it that a monetary expansion is *beggar-thyself*?

First, the overall impact of changes in monetary stance depends on the rate of collective bargaining coverage. More centralized labor markets lead unions to perceive their wage claims as improving the terms of trade. It turns out that the traditional incentive of monetary policy to affect the terms of trade is reduced in presence of NAWS. Second, this incentive is smaller, the higher are the rates of collective wage bargaining and the degrees of openness. Third, a monetary expansion is *beggar-thyself* when “microeconomic” labor distortions are

relatively lower than “strategic” distortions.

All the conclusions can be read in term of the interactions between the monopolistic distortions in the labor market and the terms of trade externalities with a specific attention given to the different degree of centralization in wage setting and the optimal determination of the monetary policy either in a non cooperative or in a cooperative setting.

Although shedding new lights on the perceived policy trade-offs between internal and external objectives, the framework is deliberately kept oversimplified so as to draw policy relevant conclusions from analytical results. The model can be extended in many ways, for example by including productivity or demand shocks as well as more general preferences. I expect however results to be robust to such extensions. Finally, I am aware that the cost of this approach is to give up a quantitatively reliable characterization of the monetary policy transmission channel. I have left this as a subject for future research.

Appendixes

A Impact of union’s wage on aggregate wage

From the wage index (11), I obtain

$$\begin{aligned}
\frac{\partial W}{\partial W(u)} &= \frac{\partial}{\partial W(u)} \left[\int_0^1 W(j)^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}} \\
&= \frac{\partial}{\partial W(u)} \left[\int_{j \in u} W(j)^{1-\sigma} dj + \int_{j \notin u} W(j)^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}} \\
&= \frac{1}{n} \left[\frac{W(u)}{W} \right]^{-\sigma} = \frac{1}{n},
\end{aligned} \tag{43}$$

where the last equality holds in a symmetric equilibrium, i.e. when $W(u) = W$.

B Elasticity of labor demand perceived by the u -th union

CP shows that policy shocks do not lead to international redistribution of wealth through current account changes since there are no changes in national net-asset positions, $B = \bar{B} = 0$. In equilibrium the ratio of home and foreign consumption (in the short and long run) is constant and equal to $\gamma/(1 - \gamma)$. Thus, combining the above and the purchasing power parity ($P = \mathcal{E}P^*$ and $\bar{P} = \overline{\mathcal{E}P^*}$) conditions with the money market equilibria (14), (21), (15), and (22), I have

$$\mathcal{E} = \bar{\mathcal{E}} = \frac{\bar{M}}{\bar{M}^*} \left(\frac{\gamma}{1-\gamma} \right)^{-\rho} \quad (44)$$

and

$$i = i^* = \delta. \quad (45)$$

From (12) aggregate demand (18) can then be rewritten as follows:

$$Y = \mathcal{F}^{1-\gamma} \frac{C}{\gamma_W} = \frac{\mathcal{F}^{1-\gamma}}{\gamma_W} \left[\frac{\beta(1+i)}{\bar{P}\gamma_W} W \mathcal{F}^{1-\gamma} \right]^{-\frac{1}{\rho}} \bar{C}, \quad (46)$$

where the second term is derived from using the Euler equation (13).

As wages are set under discretion, past and future variables are taken as given. It turns out that the elasticity of aggregate labor demand to changes in the wage W is

$$\Sigma_Y \equiv - \frac{\partial \log Y}{\partial \log W} = \frac{(\rho-1)(1-\gamma) + 1}{\rho}, \quad (47)$$

implying the following elasticity of labor demand to *real* wage perceived by the u -th union for each of its members

$$\phi \equiv - \frac{\partial \log \ell(u)}{\partial \log W(u)/P} = \frac{\frac{1+(1-\gamma)(\rho-1)}{n\rho} + \left(1 - \frac{1}{n}\right) \sigma}{1 - \frac{\gamma}{n}}, \quad (48)$$

where I used

$$\Sigma_P \equiv \frac{\partial \log P}{\partial \log W(u)} = \frac{\partial \log(W \mathcal{F}^{1-\gamma}/\gamma_W)}{\partial \log W(u)} = \frac{\gamma}{n} \quad (49)$$

and

$$\left. \frac{\partial \mathcal{F}}{\partial W(u)} \right|_{W(-u)} = - \frac{\mathcal{E}W^*}{W^2} \left. \frac{\partial W}{\partial W(u)} \right|_{W(-u)} = - \frac{\mathcal{E}W^*}{W^2} \frac{1}{n}. \quad (50)$$

References

- ACOCCELLA, N., AND G. DI BARTOLOMEO (2004): “Non-neutrality of monetary policy in policy games,” *European Journal of Political Economy*, 20, 695–707.
- BENIGNO, G., AND P. BENIGNO (2003): “Price Stability in Open Economies,” *Review of Economic Studies*, 70(4), 743–764.

- BENIGNO, P. (2002): “A simple approach to international monetary policy coordination,” *Journal of International Economics*, 57(1), 177–196.
- BRATSIOTIS, G., AND C. MARTIN (1999): “Stabilisation, Policy Targets and Unemployment in Imperfectly Competitive Economies,” *Scandinavian Journal of Economics*, 101(2), 241–56.
- CALMFORS, L., AND J. DRIFFILL (1988): “Bargaining Structure, Corporatism, and Macroeconomic Performance,” *Economic Policy*, 6, 14–61.
- CANZONERI, M. B., AND D. W. HENDERSON (1988): “Is sovereign policymaking bad?,” *Carnegie-Rochester Conference Series on Public Policy*, 28(1), 93–140.
- CAVALLARI, L. (2001): “Macroeconomic Performance and Wage Bargaining in a Monetary Union,” *Empirica*, 28(4), 419–433.
- CORICELLI, F., A. CUKIERMAN, AND A. DALMAZZO (2004): “Economic Performance and Stabilisation Policy in a Monetary Union with Imperfect Labor and Goods’ Markets,” in *European Monetary Integration*, ed. by H. W. Sinn, M. Widgren, and M. Kothenburger. MIT Press.
- (2006): “Monetary Institutions, Monopolistic Competition, Unionized Labor Markets and Economic Performance,” *Scandinavian Journal of Economics*, 108(1), 39–63.
- CORSETTI, G., AND P. PESENTI (2001): “Welfare and Macroeconomic Interdependence,” *The Quarterly Journal of Economics*, 116(2), 421–445.
- (2005): “International dimensions of optimal monetary policy,” *Journal of Monetary Economics*, 52(2), 281–305.
- CUBITT, R. P. (1992): “Monetary Policy Games and Private Sector Precommitment,” *Oxford Economic Papers*, 44(3), 513–30.
- CUCINIELLO, V. (2009): “The Welfare Effect of Foreign Monetary Conservatism with Non-Atomistic Wage Setters,” Center for Fiscal Policy Working Paper Series 08-2009, EPFL.
- CUKIERMAN, A., AND F. LIPPI (1999): “Central bank independence, centralization of wage bargaining, inflation and unemployment:: Theory and some evidence,” *European Economic Review*, 43(7), 1395–1434.
- (2001): “Labour Markets and Monetary Union: A Strategic Analysis,” *Economic Journal*, 111(473), 541–65.

- ERCEG, C. J., D. W. HENDERSON, AND A. T. LEVIN (2000): "Optimal monetary policy with staggered wage and price contracts," *Journal of Monetary Economics*, 46(2), 281–313.
- GNOCCHI, S. (2009): "Non-Atomistic Wage Setters and Monetary Policy in a New Keynesian Framework," *Journal of Money, Credit and Banking*, 41(8), 1613–1629.
- GUZZO, V., AND A. VELASCO (1999): "The case for a populist Central Banker," *European Economic Review*, 43(7), 1317–1344.
- HOLDEN, S. (2003): "Wage setting under different monetary regimes," *Economica*, 70(2), 251–265.
- INTERNATIONAL LABOUR OFFICE (2008): "Global Wage Report 2008/09: Minimum wages and collective bargaining: Towards policy coherence," Discussion paper, ILO.
- JENSEN, H. (1993): "International monetary policy cooperation in economies with centralized wage setting," *Open Economies Review*, 4(3), 269–285.
- LAWLER, P. (2000): "Centralized Wage Setting, Inflation Contracts, and the Optimal Choice of Central Banker," *Economic Journal*, 110(463), 559–575.
- LIPPI, F. (2003): "Strategic Monetary Policy with Non-Atomistic Wage Setters," *Review of Economic Studies*, 70(4), 909–919.
- NICKELL, S., L. NUNZIATA, AND W. OCHEL (2005): "Unemployment in the OECD Since the 1960s. What Do We Know?," *Economic Journal*, 115(500), 1–27.
- OBSTFELD, M., AND K. ROGOFF (1995): "Exchange Rate Dynamics Redux," *Journal of Political Economy*, 103(3), 624–60.
- OECD (2004): *Employment Outlook*. Paris: OECD.
- OSWALD, A. J. (1985): "The Economic Theory of Trade Unions: An Introductory Survey," *Scandinavian Journal of Economics*, 87(2), 160–93.
- ROGOFF, K. (1985): "Can international monetary policy cooperation be counterproductive?," *Journal of International Economics*, 18(3-4), 199–217.
- SKOTT, P. (1997): "Stagflationary Consequences of Prudent Monetary Policy in a Unionized Economy," *Oxford Economic Papers*, 49(4), 609–22.

SOSKICE, D., AND T. IVERSEN (1998): "Multiple Wage-Bargaining Systems in the Single European Currency Area," *Oxford Review of Economic Policy*, 14(3), 110–24.

——— (2000): "The Nonneutrality Of Monetary Policy With Large Price Or Wage Setters," *The Quarterly Journal of Economics*, 115(1), 265–284.

SUMMERS, L., J. GRUBER, AND R. VERGARA (1993): "Taxation and the Structure of Labor Markets: The Case of Corporatism," *Quarterly Journal of Economics*, 108(2), 385–411.

TILLE, C. (2001): "The role of consumption substitutability in the international transmission of monetary shocks," *Journal of International Economics*, 53(2), 421–444.

VARTIAINEN, J. (2002): "Relative Prices in Monetary Union and Floating," *Scandinavian Journal of Economics*, 104(1), 277–287.