Strategic interactions between «non-atomistic» wage setters, fiscal policy and asset markets in a NK-DSGE model: Do they really matter for monetary policy?

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Abstract

In this paper we focus on whether and how institutions may affect the framework for monetary policy analysis, i.e. the aggregate dynamics of the economy, the stability properties of simple interest rate rules and the policy trade-offs.

In particular, we postulate that our economy is characterized by strategic interactions between «non-atomistic» wage setters, countercyclical fiscal policy and limited asset market participation: «Non-atomistic» unions have a motive to moderate wage increases when, the degree of fiscal countercyclical policy increases (i.e. the so-called «Social Pacts», where governments offer fiscal expansion in exchange for wage restraint), or/and the fraction of Non-Ricardian households or the mass of unions (degree of wage setting centralization) decreases.

In an augmented NK-DSGE model with limited asset market participation, we find that these strategic interactions determine both the slope of the New Keynesian IS and Phillip curve, and therefore, they have interesting implications for the properties of widely used interest rate rules, the dynamics of the economy and the inflation/output gap volatility trade-offs. In particular, we found that i) the determinacy region may be dependent on the incentive to moderate or not wage claims, and ii) the policy trade-offs for the monetary authority, implied by the cost-push shock, are endogenized: «*Lean against the wind»* policy is dependent of the distortions in labour and asset markets and the degree of fiscal policy countercyclicality. The later result suggests the stabilisation role of the institutions (e.g. the «Social Pacts»), when the monetary authority is unable to commit to future policies.

Keywords: Non atomistic wage setters, monetary policy, fiscal policy, business cycle, limited asset markets participation, Social Pacts, policy trade – offs.

JEL codes : E24, E32, E44, E52, E62, E63

1 Introduction

Labor relations in many European countries have been marked by longstanding social partnership. The first generation «Social Pacts» [1] sought to trade wage moderation for higher public expenditures (welfare expenditures)/tax consessions and employment creation (Avdagic, 2010; Accocella et al. 2007a; Hassel, 2010; and Avdagic and Visser, 2011) or lower inflation, e.g. after the oil shocks (Hassel, 2003, 2010). Unlike corporatism in the 1970s, «competitive corporatism» (Rhodes, 1998)[2] in 1980s and 1990s, was seen as a part of a disinflation strategy, in order to face the challenges of globalization, economic integration and the monetary unification in Europe (Avdagic, 2010; Hancké and Rhodes, 2005; Hassel, 2010; Avdagic and Visser, 2011).

Even though «Social Pacts», as a formula for policy making based on compromises between governments and social partners, were very popular in Europe (see Appendix 1 - Table 1), theoretical analyses of macroeconomic outcomes in corporatist economies are restricted: First, the literature almost exclusively focuses on strategic interactions between «non-atomistic» wage setters and monetary policy, rather than fiscal policy [see for example Lippi (2003); Cukierman and Lippi (1999); Di Bartolomeo (2013); Bratsiotis and Martin (1999); Soskice and Iversen (2000)]. Indeed, the analysis of interactions between trade union behavior and fiscal policy is restricted. Notable exceptions are Larsson (2012), Cavallari (2010, 2012) and Acocella et al. (2007b). Second, only few authors incorporate the literature on strategic interactions between monetary policy and trade unions into the standard New-Keynesian model, [see for example Gnocchi (2005, 2006, 2009); Acocella et al. (2008, 2013); Cuciniello (2008, 2011); and Coricelli et al. (2006)], while, so far, there is no literature concerning fiscal policy interactions with labor market, in this kind of models.

This gap is linked to the «conventional assignment» in the standard New Keynesian model, according to which monetary policy can determine inflation (control demand), while fiscal policy prevents debt from becoming unstable (Woodford, 2011; Clarida et al. 1999, Kirsanova et al. 2009, etc). Considering fiscal policy as exogenous, and so not suitable for demand stabilization issues, can be justified on grounds of, among others, the virtue of «Ricardian Equivalence». As a result, the focus of the relevant literature is restricted on institutional constraints on monetary policymaker as a key ingredient in shaping macroeconomic outcomes, i.e, central bank conservatism or independence, disregarding possible interactions either between fiscal authority and trade unions or fiscal authority and monetary authority.

The purpose of this paper is to add to the literature by revealing the importance of these social partnerships, especially between fiscal authority and trade unions, for the conduct of monetary policy. Our rationale for government intervention in wage bargaining and income policy is in line with Hassel's (2010) argument[3]: Governments prefer to seek negotiations with trade unions on wages, if the monetary authority is

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[1] «Social Pacts» are define as "publicly announced formal policy contracts between the government and social partners over income, labour market or welfare policies that identify explicitly policy issues and targets, means to achieve them, and tasks and responsibilities of the signatories" (Avdagic and Visser, 2011).

[2] The second generation «Social Pacts» were designed to reduce governments' influence and to increase the emphasis on active labour market policies on the supply side, while wage moderation still features (Avdagic, 2010; Accocella et al. 2007; Hassel, 2010;Avdagic and Visser, 2011).

[3] Except from the lack of credibility, Hassel (2010) emphasizes the uncertainty about monetary policy, the government's political dependence on the social partners and the sensitivity of the wage bargaining institutions as prerequisites for the government to seek direct negotiations with trade unions.

unable to credible commit to future policies and, therefore, in using the expectations channel to help stabilize inflation expectations.

The setup of our work is closely related to Gnocchi (2005, 2006, 2009), Acocella et al. (2008, 2013), Cuciniello (2008, 2011), Coricelli et al. (2006). In contrast to the preceding literature, where fiscal policy is being considered as exogenous, we assume that fiscal policy can stabilize economy: whenever output/employment is below its target, the fiscal authority increases public expenditures. Moreover, for fiscal policy to have impact on aggregate demand, we must break the «Ricardian Equivalence». An easy way to do this is to assume that a fraction of households do not have access to financial markets. Except from being simplifying, this choice for breaking the «Ricardian Equivalence» help us to reveal a totally new aspect in the literature on strategic interactions between labor market and the macroeconomic authorities: The concern of «non-atomistic» unions for their members who can't smooth consumption. With the global financial crisis spreading to the real economy, we believe that this is an interesting area for further research.

In particular, our paper describes a New Keynesian DSGE model which incorporates three main assumptions-departures from the standard model (Woodford, 2011 ; Clarida et al. 1999; Galí , 2015; and Walsh, 2017).

The first one is «non-atomistic» wage setters, who internalize the consequences of their wage decisions on aggregate variables.

The second one is the incorporation of countercyclical fiscal policy that share similar characteristics with the Taylor-rule in monetary economics. Combining this modeling choice with the first assumption, gives us the opportunity to incorporate «Social Pacts» into a standard New-Keynesian Model.

The latter assumption is limited asset market participation, since a fraction of the households do not have access to asset markets [see for example Bilbiie (2005, 2008, 2013); Galí et al. (2004, 2007); Ascari et al. (2011, 2017); Rossi (2014); and Di Bartolomeo and Rossi (2005)] and it is a prerequisite for the second hypothesis.

So, in our model, various characteristics of institutions, such as the degree of asset market participation, central wage bargaining and counteryclicality of fiscal policy, form a specific labor market (labor supply): We postulate that «non-atomistic» unions have a motive to moderate wage increases when, the degree of fiscal policy countercyclicality increases (i.e. the so-called «Social Pacts», where governments offer fiscal expansion in exchange for wage restraint), or/and the fraction of Non-Ricardian households or the mass of unions (degree of wage setting centralization) decreases.

It's worth noticing that, this dependence of the wage policy decisions from (the characteristics of) institutions is the cornstore of our model and drives our results. Indeed, these interactions between trade unions, fiscal policy and asset markets alter both the slope of the New Keynesian IS and Phillip curve (NKISC and NKPC). The latter have, beyond doubt, interesting implications for the framework for monetary policy analysis, i.e. the stability properties of simple interest rate rules, the aggregate dynamics of the economy and the inflation/output gap volatility trade-offs for the discretionary monetary policy (in the aftermath of a cost push shock).

So, this paper adds to the recent literature in various ways. One strand of the literature investigates the stability properties of simple interest rate rules and relates the latter with the limited asset market participation hypothesis. This assumption by itself and labor market conditions (intertemporal elasticity of labor supply, wage stickiness, etc) can change dramatically the slope of the New Keynesian IS curve (NKISC) and consequently the properties of widely used interest rate rules [see for example Bilbiie ,2008; Bilbiie and Straub, 2004; Gali et al. 2004, 2005; and Rossi, 2014)]. We found that, under the limited asset market participation hypothesis, whenever unions make more aggressive wage demands, the area where the NKISC's slope preserves its negative (positive) sign is shrunk (extended). Moreover, we postulate that our determinacy region may depend on the incentive for aggressive wage claims. In addition, we argued that, the ability of monetary authority to activate countercyclical fiscal policy, extends (shrinks) the area where the NKISC preserves its negative (positive) sign.

Second, it is well known that, in the standard New Keynesian model, if cost-push shocks drive inflation, the «*Divine coincidence*» (Blanchard and Gali, 2007) disappears automatically, generating a meaningful policy problem in terms of the appropriate formatting of monetary policy: Optimal discretionary monetary policy pursue a «*Lean against the wind»* policy, as fighting against inflation calls for a lowering of the output gap (Clarida et al. 1999; Woodford, 2011; and Walsh 2017). This trade-off between the variability of inflation and the output gap is unaffected not only by the fiscal policy, since the latter is largely considered as exogenous (modeling assumption of «Ricardian Equivalence»), but also by the presence of «atomistic» wage setters, who cannot internalize the macroeconomic effects of their wage decisions. In our model, the policy trade-offs for monetary authority, implied by the cost-push shock term in the NKPC, are endogenized: «*Lean against the wind»* policy is dependent of the distortions in labour and asset markets and the degree of fiscal policy countercyclicality. These results suggest the stabilization role of the institutions (e.g. of the «Social Pacts»).

Taking into account the results set out above, it may be a fruitful improvement to merge the New-Keynesian literature on monetary and fiscal policy interactions under limited asset market participation with the literature on corporatism.

The organization of the paper is as follows. In Section 2 we outline our model. Section 3 discusses the modified aggregate dynamics, i.e. we look at how these strategic interactions affect: i) the conditions under which the rational expectation equilibrium is determined (Section 3.1) and ii) the responses of the main endogenous variables to a mark-up shock (Section 3.2). In Section 4 we look at the extent to which these interactions between labor markets, asset markets and the fiscal policy stance, enhance or detract from the ability of the monetary authorities to stabilize output and inflation. Section 5 concludes.

2. Model

In this section, we set up the economy. We assume that the private sector, as well as the monetary authority, can be described by a conventional DSGE New- Keynesian model augmented by limited asset market participation. Since the model is well known, we keep the description brief as possible.

2.1 Households

We assume a continuum of infinitely-lived households, indexed by $j \in (0,1)$. An exogenous fraction $1-\lambda$ of households have access to asset markets, where they can trade a full set of contingent securities (Ricardian households or optimizers (O)). The remaining fraction λ of households just consume their current labor income (Non-Ricardian or rule of thumb (ROT) households).

The instantaneous utility function is common across households and its arguments are private consumption, C_{jt}^{S}, public consumption, G_{jt}, and hours worked in a non-Walrasian-type labor market, L_{jt}^{S}:

$$U_t \equiv u(C_{jt}^{S}) + q(G_{jt}) - v(L_{jt}^{S}) = \frac{\left(C_{jt}^{S}\right)^{1-1/\sigma}}{1-1/\sigma} + \frac{\left(G_{jt}\right)^{1-1/\sigma}}{1-1/\sigma} - \frac{\left(L_{jt}^{S}\right)^{1+1/\phi}}{1+1/\phi} \tag{1}$$

where $S = O, ROT$ stands for household type , $1/\sigma$ is the relative risk aversion and $1/\phi$ represents the elasticity of utility from supplying labor (Frisch elasticity).

C_{jt}^{S} is a standard consumption bundle , $C_{jt}^{S} = \left[\int_0^1 \left(C_{jt}^{S}(i)^{(\varepsilon_t-1)/\varepsilon_t}\right) di\right]^{\varepsilon_t/(\varepsilon_t-1)}$, where $i \in (0,1)$ indexes the type of good and ε_t denotes the elasticity of substitution between any pair of goods. This elasticity is assumed to be stochastic, to allow for shocks to the mark-up of firms (cost push shocks), (see for example Steisson, 2003 and Ireland, 2004). In this way, we allow for microfounded cost-push shock in the Phillips curve, which automatically makes the «*Divine Coincidence*» (Blanchard and Gali, 2007) disappear and policy trade-offs to appear (Woodford, 2011).

Ricardian households

The optimal demand for each type of good $i \in (0,1)$ for each Ricardian household $j \in (0,1)$, is standard and equal to $C_{jt}^{O}(i) = \left[P_t(i)/P_t\right]^{-\varepsilon_t} C_{jt}^{O}$, while the price index is given by $P_t = \left[\int_0^1 \left(P_t(i)^{1-\varepsilon_t}\right) di\right]^{1/(1-\varepsilon_t)}$. Given this optimal bundle of consumption goods, the representative Ricardian household must choose the optimal private consumption and nominal asset holdings vector that maximizes the lifetime utility function, $\mathrm{E}_0\left\{\sum_{t=0}^{\infty} \beta^t \left[u(C_{jt}^{0}) + q(G_{jt}) - v(L_{jt}^{0})\right]\right\}$, where β is the subjective discount factor with $\beta \in (0,1)$. The flow budget constraint can be written as

$$P_t C_{jt}^{o} + \mathrm{E}_t\left[Q_{t,t+1} A_{t+1}^{o}\right] \leq A_t^{o} + W_{jt}^{r} P_t L_{jt}^{o} + P_t D_t^{o} \tag{2}$$

In each period t Ricardian households can purchase any desired state-contingent nominal payment A_{t+1}^{o} in period $t+1$ at the dollar cost $\mathrm{E}_t\left[Q_{t,t+1} A_{t+1}^{o}\right]$. The variable $Q_{t,t+1}$ denotes the stochastic discount factor between period $t+1$ and t. The gross riskless interest rate, I_t, is associated to the stochastic discount factor, $1/I_t = \mathrm{E}_t\left[Q_{t,t+1}\right]$. W_{jt}^{r} is the real wage for the j- type hours worked and D_t^{o} represents the real dividend payments for Ricardian households**.** Moreover Ricardian households receive post-tax firm profits, O_t^{PT} in the form of real dividend payments, where Λ_t is a proportional profit tax (Stehn, 2009):

$$D_t = \left(1 - \Lambda_t\right) O_t \equiv O_t^{PT} \tag{3}$$

The first order condition is the conventional «Euler equation for consumption»[4,5]:

$$\beta \mathrm{E}_t \left\{ \mathrm{P}_t \left(C^o_{t+1} \right)^{-1/\sigma} / \mathrm{P}_{t+1} \left(C^o_t \right)^{-1/\sigma} \right\} = 1/I_t \tag{4}$$

Non Ricardian households

The optimal bundle of consumption goods for each Non Ricardian household is the same as the one of Ricardian households. Since this type of household simply consumes its current disposable income from labor, its level of private consumption, each period t, comes through its budget constraint.

$$P_t C^{ROT}_{jt} = W^r_{jt} P_t L^{ROT}_{jt} \tag{5}$$

For future reference it is useful to note that (4) and (5) can be respectively written in log-linearized form[6] - using first order Taylor expansion around the zero inflation efficient steady state (see Section 2.6) - as:

$$\hat{c}^0_t = \mathrm{E}_t \hat{c}^0_{t+1} - \sigma\left(\hat{i}_t - \mathrm{E}_t \pi_{t+1}\right) \tag{6}$$

$$\hat{c}^{ROT}_t = \hat{w}^r_t + \hat{l}^{ROT}_t \tag{7}$$

2.2 Firms

Monopolistically competitive firms, produce a differentiated good $i \in (0,1)$ with constant return to scale technology:

$$\mathrm{Y}_t(i) = L_{it} \tag{8}$$

where L_{it} is a standard CES aggregator index of labor input used by i- firm, given by $L_{it} = \left[\int_0^1 L_{it}(j)^{(\varepsilon_w - 1)/\varepsilon_w} dj\right]^{\varepsilon_w/(\varepsilon_w - 1)}$, with the elasticity of substitution between any pair of labor types $\varepsilon_w > 1$ and where $L_{it}(j)$ is the quantity of j-type labor employed by i-firm. We assume that $L_{it}(j)$ is uniformly distributed across the two different types of households.

The optimal i-firm's demand for each j-type of labor is standard and equal to $L_{it}(j) = \left[W^r_t(j)/W^r_t\right]^{-\varepsilon_w} L_{it}$ and the associated wage index is given by $W^r_t = \left[\int_0^1 \left(W^r_t(j)^{1-\varepsilon_w}\right) dj\right]^{1/(1-\varepsilon_w)}$. After aggregating across firms we obtain:

$$L_t(j) = \left[W^r_t(j)/W^r_t\right]^{-\varepsilon_w} L_t \tag{9}$$

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[4] We assume no Ponzi schemes and that the nominal interest rate is positive at all times.

[5] The stochastic discount factor , $Q_{t,t+1}$, is given by $Q_{t,t+1} = \beta\left(C^o_{t+1}/C^o_t\right)^{-1/\sigma}\left(\mathrm{P}_t/\mathrm{P}_{t+1}\right)$.

[6] Variables in levels are denoted with capital letters, logged variables with small letters. Small letters with a hat denote the log-deviation of a variable from its steady-state value, e.g. $\hat{x}_t = \log(X_t/X) = (X_t - X)/X$. The only exception is profits which are defined as a fraction of steady-state output (since their steady-state value is zero).

Moreover, given this optimal labor vector, firms have to set prices such that the expected discounted value of after tax profit,

$$E_t \sum_{s=0}^{\infty} \theta^s \left[Q_{t,t+s} \left(1 - \Lambda_{t+s}\right) \left(\frac{P_t^*}{P_{t+s}} Y_{t+s}(i) - \frac{TC_{t+s}(i)}{P_{t+s}} \right) \right] \tag{10}$$

is maximized with respect to the technology production, (8), a sequence of total demand constraints, $Y_t(i) = \left[P_t(i)/P_t\right]^{-\varepsilon_t} Y_t$, and, Calvo price staggering hypothesis. Each firm resets its price and set P_t^* with a fixed probability $\left(1-\theta\right)$ in each period t. So θ measures the degree of price stickiness. Note that the proportional profit tax, Λ_t, is non-distortionary, as our model abstracts from capital or investment.

The real marginal cost, which is common across firms because of the constant return to scale technology, can be written as $MC_t^r(i) = MC_t^r = \left(1-\mu_w\right)W_t^r$, where μ_w denotes a steady-state (time invariant) employment subsidy (which will be discussed in section 2.6).

Define $\mu_t = \varepsilon_t / \left(\varepsilon_t - 1\right) > 1$ as the «time varying desired mark-up» (i.e. under flexible prices), the first order condition for price setting is standard (Gali, 2015; Woodford, 2011) and given by $P_t^* = \mu_t \dfrac{E_t \sum_{s=0}^{\infty} (\theta\beta)^s \left(1-\Lambda_{t+s}\right)\left(C_{t+s}^o\right)^{-1/\sigma} \mathrm{P}_{t+s}^{\varepsilon_t} Y_{t+s} MC_{t+s/t}}{E_t \sum_{s=0}^{\infty} (\theta\beta)^s \left(1-\Lambda_{t+s}\right)\left(C_{t+s}^o\right)^{-1/\sigma} \mathrm{P}_{t+s}^{\varepsilon_t} Y_{t+s}}$.

Finally, the last two equations can be respectively written in log-linearized form as:

$$mc_t^r = w_t^r + \ln\left(1-\mu_w\right) \tag{11}$$

$$p_t^* = \ln \mu_{t+s} + \left(1-\theta\beta\right) E_t \sum_{s=0}^{\infty} \left(\theta\beta\right)^s \left(mc_{t+s}^r + p_{t+s}\right) \tag{12}$$

2.3 Fiscal and monetary authority

The fiscal authority purchases consumption goods, G_t, where G_t is defined analogously to consumption aggregator, i.e. $G_t \equiv \left[\int_0^1 G_t(i)^{(\varepsilon_t-1)/\varepsilon_t} di\right]^{\varepsilon_t/(\varepsilon_t-1)}$, with optimal government demand schedules equal to $G_t(i) = \left[P_t(i)/P_t\right]^{-\varepsilon_t} G_t$.

We do not consider the employment subsidy, μ_w, and the associated level of lump-sum taxes, T, to be policy instruments which could be varied over time to stabilize the economy. So, according to budget constraint, fiscal authority finances its spending by levying a proportional profit tax, $G_t = \Lambda_t \mathrm{O}_t$, where O_t denotes aggregate real profits.

Furthermore, with government spending as its instrument, we assume that fiscal authority reacts to output changes according to the following simple feedback rule, where the coefficient ϕ_{Y} measures the degree of fiscal policy countercyclicality:

$$G_t = G\left(Y_t / Y\right)^{-\phi_Y} \tag{13}$$

Monetary policy sets the nominal interest rate according to a simple current-looking Taylor rule (Clarida et al, 1999), where ϕ_{Π} is the single monetary policy parameter:

$$I_t = I(\Pi_t/\Pi)^{\phi_{\Pi}} \tag{14}$$

Following Leeper (1991), monetary policy is called active (passive) if nominal interest rate rises more (less) than one-for-one with the current inflation rate, i.e. $\phi_{\Pi} > 1$ $(\phi_{\Pi} < 1)$.

Log-linearization of these rules yields:

$$\hat{i}_t = \phi_{\Pi}\pi_t \tag{15}$$

$$\hat{g}_t = -\phi_Y \hat{y}_t \tag{16}$$

2.4 Unions

There is a finite number of labor unions, n, indexed by $z \in [1,2,..n]$, each representing a continuum of households (workers) $j \in (0,1)$, of which a fraction λ are members of Non-Ricardian households and the remaining $1-\lambda$ fraction consists of Ricardian households. Each union has mass $n^{-1} > 0$ as all workers (independently of consumer behavior) are unionized and they split equally among unions. Note that n^{-1} can be interpreted as the degree of wage-setting centralization as well as unions' ability to internalize the consequences of their wage policy on aggregate variables: the bigger is n^{-1} the higher is this «internalization effect» (Guzzo and Velasco, 1999).

Each union employs one particular type of labor (independently of the type of households they originate from), that is different from the type of labor offered by other unions. The labor services supplied by each union is an aggregator of the members' labor services, i.e. $L_{zt} = \left[\int_0^1 L_{zt}(j)^{(\varepsilon_w - 1)/\varepsilon_w} dj\right]^{\varepsilon_w/(\varepsilon_w - 1)}$, where ε_w is the elasticity of substitution across different types of households.

The labor demand function for a union's z-type labor's services is given by

$$L_t(z) = L_{zt} = (W_{zt}/W_t)^{-\varepsilon_w} L_t \tag{17}$$

We assume that each union sets the real wage (instead of the nominal) on behalf of its members $j \in z$, W_{zt}^r, taking as given the wage set by the other unions ,W_{-zt}^r, in order to keep the wage setting equation - and thus the model - as simple as possible. For given the imposed by the representative union real wage, its members (households) are willing to supply whatever quantity of labor is required in order to clear the labor market.

In a symmetric equilibrium, each «non-atomistic», $(1 < n < \infty)$, union's ability to internalize the consequences of its own actions on aggregate real wage is proportional to union size (Bratsiotis and Martin, 1999; Lippi, 2003; and Gnocchi, 2009).

$$\Sigma_W \equiv \frac{\partial W_t^r}{\partial W_{zt}^r} \cdot \frac{W_{zt}^r}{W_t^r} = \frac{\partial W_t^r}{\partial W_{zt}^r} = \frac{1}{n} > 0 \tag{18}$$

Additionally, note that in our model, the impact effect of a unitary percentage increase in W_{zt}^{r} on L_t, Σ_L[7], is determined by two mechanisms: the «*Intertemporal Substitution of Ricardian Consumption Mechanism*», («*ISRCM*»), and the «*Non-Ricardian Disposable Income Mechanism*», («*NRDIM*»), $\left|\Sigma_L\right| = \left|\frac{dL_t}{dW_{zt}^{r}} \cdot \frac{W_{zt}^{r}}{L_t}\right| \equiv \left|\frac{dl_t}{dw_{zt}^{r}}\right| = \left|\left\{\frac{dl_t}{dw_{zt}^{r}}\right\}_{\text{ISRCM}} + \left\{\frac{dl_t}{dw_{zt}^{r}}\right\}_{\text{NRDIM}}\right|$.

According to the first mechanism, since unions are «non-atomistic», they also anticipate that a wage rise, through the marginal cost, impacts on optimal price setting and therefore on expected real interest rate. The latter decreases Ricardian consumption and therefore total demand and output. But the story does not end here. At a second stage, this change in output i) triggers the reaction of the fiscal authority [through the countercyclical policy rule, (13)] which will increase public expenditures, leading to higher output, hence aggregate labor demand, ii) decreases Non-Ricardian labor income, Non-Ricardian consumption, output and aggregate labor demand. Under the baseline calibration, (ii) always dominates (i). So «*ISRCM*» is always negative and equal to $\left\{\frac{dl_t}{dw_{zt}^{r}}\right\}_{\text{ISRCM}} = -\frac{\sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)n^{-1}}{\left[1-\lambda\rho+(1-\rho)\phi_Y\right]} < 0$.

Note that the assumption that $0 < \lambda < 1$ is crucial in our model, since it implies a totally-new impact of W_{zt}^{r} on L_t through the «*Non-Ricardian Disposable Income Mechanism*» («*NRDIM*»). According to the latter, «large» unions perceived that their wage demands, have led to higher Ricardian consumption and hence aggregate demand and output. In a second stage, this increased output i) leads the fiscal authority to decreases public expenditures and so output decreases too, and, ii) positively impacts on Non-Ricardian consumption and output. The final impact on output and hence on aggregate labor demand is positive. So, $\left\{\frac{dl_t}{dw_{zt}^{r}}\right\}_{\text{NRDIM}} = \frac{\lambda\rho n^{-1}}{\left[1-\lambda\rho+(1-\rho)\phi_Y\right]} > 0$. These findings are summarized in Proposition 1.

<u>Proposition 1</u>

a) For $1 < n < \infty$ and for plausible parameters values, i.e. $\lambda > \lambda_{\Sigma_L}^{*} \equiv \sigma(1-\theta)(1-\theta\beta)/\left[\sigma(1-\theta)(1-\theta\beta)+1\right] = 0{,}0312$, Σ_L, is not negative - as it used to be in the relevant literature of homogenous households - see for example Lippi (2003), Cuciniello (2011), Cukierman and Lippi (1999) and Gnocchi (2009) - but positive. This is due to the fact that the positive «*Non-Ricardian Disposable Income Mechanism*», which is the result of limited asset market participation hypothesis, $0 < \lambda < 1$, dominates the negative «*Intertemporal Substitution of Ricardian Consumption Mechanism*».

$$\Sigma_L = \frac{dl_t}{dw_{zt}^{r}} = \frac{\lambda\rho n^{-1} - \sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)n^{-1}}{\left[1-\lambda\rho+(1-\rho)\phi_Y\right]} > 0 \qquad (19)$$

b) For $1 < n < \infty$ and $0 < \lambda < 1$, Σ_L is an increasing function of the ratio of Non-Ricardian households, λ, and the degree of central wage setting , n^{-1} , and a decreasing

[7] Or «*Output Effect*» - using Lippi's (2003) terminology.

function of the degree of fiscal policy countercyclicality, ϕ_Y. Formally, it is easy to show that:

$$\frac{d\Sigma_L}{dn^{-1}} = \frac{\lambda\rho - \sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)}{\left[1-\lambda\rho+(1-\rho)\phi_Y\right]} > 0 \tag{20}$$

$$\frac{d\Sigma_L}{d\lambda} = \frac{\rho+(1-\rho)\sigma\rho(1-\theta)(1-\theta\beta)\left[1+\phi_Y(1+\rho)\right]}{\left[1-\lambda\rho+(1-\rho)\phi_Y\right]^2 n} > 0 \tag{21}$$

$$\frac{d\Sigma_L}{d\phi_Y} = -\frac{(1-\rho)\left[\lambda\rho-\sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)\right]}{\left[1-\lambda\rho+(1-\rho)\phi_Y\right]^2 n} < 0 \tag{22}$$

Limited asset market participation (big λ), strengthens not only the dominant «*Non-Ricardian Disposable Income Mechanism*», but also makes greater the multiplier process both of which leads to higher values of Σ_L. In addition, high degree of central wage setting (low n) means that «non-atomistic» unions take advantage of their position and follow aggressive wage policy. The opposite holds for the degree of the aggressiveness of fiscal policy rule, ϕ_Y, because when the latter is high, then the multiplier process is low, as less employment is induced with each round of activity.

This dependence of Σ_L on ϕ_Y, λ and n^{-1} is of vital importance to the model; because of this, institutions will have an effect on labor supply (wage-setting equation) and consequently, on the aggregate dynamics (New-Keynesian Phillips curve and IS curve).

In fact, under the presence of «non-atomistic» unions, the incentive to moderate or not wage claims relies on the elasticity of labor demand perceived by the typical z-union for each of its members, e_{L_z}, which is the weighted combination of two effects: the «*Substitution Effect*» («SE») (e.g., Cukierman and Lippi 1999; Lippi, 2003) and the elasticity of aggregate labor demand (e.g., Bratsiotis and Martin 1999, Coricelli et al. 2006; and Gnocchi, 2009)[8].

$$e_{L_z} \equiv -\frac{dl_{zt}}{dw^r_{zt}} = \underbrace{\varepsilon_w\left(1-n^{-1}\right)}_{\text{"SE"}} - \underbrace{\Sigma_L}_{\text{"ISRCM"+"NRDIM"}} \tag{23}$$

Under baseline calibration and independently of the degree of central wage bargaining, it is straightforward to show that this elasticity is always negative, $e_l < 0$ (see Appendix 2a), reflecting that the mechanisms with negative sign («SE» and «*ISRCM*»,) dominate the one with positive sign («*NRDIM*»). Note also that (see Appendix 2b):

$$e_{L_z} > 1 \tag{24}$$

Concerning the factors affecting the incentive to moderate or not wage claims, it is obvious from (23) that, with «non-atomistic» unions, $1 < n < \infty$, e_{L_z}, depends, not

[8] On the other hand, with «atomistic» wage setters or fully decentralized labor market (i.e., $n \to \infty$) and for all possible values of λ, (i.e., $0 \leq \lambda < 1$), equation (23) is simply given by the «*SE*», as «atomistic» unions do not take into account the impact of their wage claims on aggregate employment, $\lim_{n\to\infty}\Sigma_L = 0$. Thus, $\lim_{n\to\infty} e_{L_Z} = \varepsilon_W$.

only on the degree of wage-setting centralization, n^{-1}, but also, through the Σ_L, on two new parameters: The fraction of Non-Ricardian households, λ, and the aggressiveness of countercyclical fiscal policy, ϕ_Y. These parameters reflect, on the one hand, the concern of unions about their members who cannot smooth consumption, and, on the other hand, an agreement between fiscal authority and unions that the first offers fiscal expansion in exchange for wage restraint i.e. «Corporatists Pacts» or «Social Pacts».

2.4.1 Wage determination and institutions

In this section we determine and analyze the impact effect (of the characteristics) of various institutions, such as the centralization of wage setting, the degree of asset market participation and fiscal policy countercyclicality on wage policy. Such impacts seem to be very interesting as labor market (specifically the wage setting equation in our model) determines both aggregate demand and supply.

In particular, we assume that unions are benevolent and maximize the weighted sum of the utility function of their represented workers, (1), subject to budget constraints, (2) and (5), labor demand, (17) and fiscal policy rule, (16), for all members $j \in z$. The associated first order condition is given by [9]

$$\underbrace{\lambda MU_C^{ROT}\left(\frac{\partial C_{zt}^{ROT}}{\partial W_{zt}^r}+\frac{\partial C_{zt}^{ROT}}{\partial L_{zt}}\frac{dL_{zt}}{dW_{zt}^r}\right)+(1-\lambda)MU_C^{O}\left(\frac{\partial C_{zt}^{o}}{\partial W_{zt}^r}+\frac{\partial C_{zt}^{o}}{\partial L_{zt}}\frac{dL_{zt}}{dW_{zt}^r}\right)+\mathrm{M}U_G\frac{dG_{zt}}{dW_{zt}^r}}_{marginal\ cost}=$$

$$=\underbrace{-\mathrm{M}U_L\frac{dL_{zt}}{dW_{zt}^r}}_{marginal\ benefit}$$

In a symmetric equilibrium, i.e. when $W_{zt}^r = W_t^r$, we have that the optimal real wage of the unions obeys:

$$W_t^r = -\frac{\frac{\phi_Y \Sigma_L}{(e_L-1)} L_t^{-1} G_t^{-\left(\frac{1}{\sigma}-1\right)}}{\lambda\left(C_t^{ROT}\right)^{-\frac{1}{\sigma}}+(1-\lambda)\left(C_t^{O}\right)^{-\frac{1}{\sigma}}}+\frac{\frac{e_L}{(e_L-1)} L_t^{\frac{1}{\varphi}}}{\lambda\left(C_t^{ROT}\right)^{-\frac{1}{\sigma}}+(1-\lambda)\left(C_t^{O}\right)^{-\frac{1}{\sigma}}} \quad (25)$$

Note that, under a perfectly competitive labor market or a labor market with «atomistic» unions, (25) modifies to [see for example Gali et al. (2004, 2005), Ascari et al. (2017) and Bilbiie (2008)]:

$$\left(W_t^r\right)^{n\to\infty}=\frac{\frac{\varepsilon_w}{(\varepsilon_w-1)} L_t^{\frac{1}{\varphi}}}{\lambda\left(C_t^{ROT}\right)^{-\frac{1}{\sigma}}+(1-\lambda)\left(C_t^{O}\right)^{-\frac{1}{\sigma}}} \quad (26)$$

So, (25) is identical to (26) except from the first term and the dependence of wage setting mechanism on e_L and hence – through Σ_L - on (various characteristics of)

[9] Where $MU_C^{ROT}=\left(C_{zt}^{ROT}\right)^{-1/\sigma}$, $MU_C^{O}=\left(C_{zt}^{O}\right)^{-1/\sigma}$, $\mathrm{M}U_L^{ROT}=\mathrm{M}U_L^{O}=\mathrm{M}U_L=-L_{zt}^{1/\varphi}$ and $\mathrm{M}U_G=G_{zt}^{-1/\sigma}$.

institutions, i.e. ϕ_Y, λ and n^{-1}. The first term reflects the fact that a marginal increase of the real wage, through $\Sigma_L > 0$, increases total labor demand and output. This provokes the reaction of countercyclical fiscal policy, who decreases public expenditures, $\frac{dG_{zt}}{dW_{zt}^r} = \frac{dG_{zt}}{dY_t} \cdot \frac{dY_t}{dL_t} \cdot \frac{dL_t}{dW_{zt}^r} = -\frac{G_{zt}}{W_{zt}^r} \phi_Y \Sigma_L < 0$, and consequently union members' utility.

Log-linearizing (25) around the non-stochastic efficient steady state yields $\hat{w}_t^r = w_Y \hat{y}_t + w_C \hat{c}_t + w_G \hat{g}_t$, where $w_Y \equiv (1+\phi)K/\phi > 0$, $w_G \equiv (1-\sigma)(K-1)/\sigma > 0$ and $w_C \equiv 1/\sigma$. Also, we set $K = e_L/(e_L - 1) = 1 + [\phi_Y \Sigma_L (1-\rho)/(e_L - 1)] > 1$.

Finally, using (37) we get that

$$\hat{w}_t^r = w_{YY} \hat{y}_t - w_{GG} \hat{g}_t \tag{27}$$

where the corresponding coefficients are given by

$$\frac{d\hat{w}_t^r}{d\hat{y}_t} \equiv w_{YY} = w_Y + (w_C / \rho) > 0 \tag{28}$$

$$\frac{d\hat{w}_t^r}{d\hat{g}_t} \equiv -w_{GG} = -[(w_C(1-\rho)/\rho) - w_G] < 0 \tag{29}$$

The elasticity of $\hat{w}_t^r$ to $\hat{y}_t$ (slope of the labor supply curve), $\frac{d\hat{w}_t^r}{d\hat{y}_t} \equiv w_{YY}$, is the result of two impacts: The direct and the indirect impact. According to the first, higher $\hat{y}_t$ leads to higher labor demand (due to Calvo price hypothesis) and hence «non-atomistic» wage setters, who internalize the impacts of their wage policy, to set higher $\hat{w}_t^r$ (see the term w_Y). Second, higher $\hat{y}_t$, through the resource constraint equation leads to a «crowding-in effect» ($\hat{c}_t$ increases), which further reinforces the increase of the labor demand and hence $\hat{w}_t^r$ (see the term w_C / ρ). Finally, note that under baseline calibration, $w_{YY} > 1$.

An analogous interpretation also applies to $\frac{d\hat{w}_t^r}{d\hat{g}_t} \equiv -w_{GG}$, which is negative for plausible parameters values (see Appendix 2c), reflecting that loosen fiscal policy increases labor supply so that at each output level corresponds lower desirable real wage.

Note that, for $0 < \lambda < 1$ and $n \to \infty$ the log-linearised form of (26) is given by:

$$\begin{aligned}(\hat{w}_t^r)^{n\to\infty} &= \left(\frac{1}{\phi} + \frac{1}{\rho\sigma}\right)\hat{y}_t - \frac{(1-\rho)}{\rho\sigma}\hat{g}_t = \left(w_Y^{n\to\infty} + \frac{1}{\rho} w_C\right)\hat{y}_t - \frac{(1-\rho)}{\rho w_C}\hat{g}_t = \\ &= w_{YY}^{n\to\infty}\hat{y}_t - w_{GG}^{n\to\infty}\hat{g}_t\end{aligned} \tag{30}$$

It is obvious that «atomistic» unions response less to labor demand (output) changes relative to «non- atomistic» unions, since the first cannot influence aggregate labor demand, that is $w_Y \equiv \frac{1+\phi}{\phi} K - 1 > w_Y^{n\to\infty} \equiv \frac{1}{\phi}$.

Finally, our conclusions about the incentive to moderate or not wage claims (the degree of aggressiveness of unions' wage demands, w_{YY}) are summarized in Proposition 2.

Proposition 2

It's more likely that unions' wage claims (in response to output changes) are more aggressive (relatively bigger slope of labor supply curve):

a) For $1 < n < \infty$ and $0 < \lambda < 1$ rather for $n \to \infty$ and $0 < \lambda < 1$:

$$w_{YY} > w_{YY}^{n\to\infty} \tag{31}$$

b) For $1 < n < \infty$ and $0 < \lambda < 1$, the higher is n^{-1} and λ or the lower is φ_Y. Straightforward manipulations would show that (see Appendix 3 for a formal proof):

$$\frac{dw_{YY}}{dn^{-1}} = \frac{dw_{YY}}{dw_Y} \cdot \frac{dw_Y}{dK} \cdot \frac{dK}{de_L} \cdot \frac{de_L}{dn^{-1}} > 0 \tag{32}$$

$$\frac{dw_{YY}}{d\lambda} = \frac{dw_{YY}}{dw_Y} \cdot \frac{dw_Y}{dK} \cdot \frac{dK}{de_L} \cdot \frac{de_L}{d\lambda} > 0 \tag{33}$$

$$\frac{dw_{YY}}{d\phi_Y} = \frac{dw_{YY}}{dw_Y} \cdot \frac{dw_Y}{dK} \cdot \frac{dK}{de_L} \cdot \frac{de_L}{d\phi_Y} < 0 \tag{34}$$

Centralization of wage setting

The intuition for (32), i.e. the positive impact of n^{-1} on w_{YY}, is the following: For $0 < \lambda < 1$, the higher is n^{-1} the bigger is the size of the dominant «*NRDIM*» (and hence Σ_L) as well as the smaller is the size of the «*SE*», both of which results in lower values of e_{L_z} - i.e. lower negative multiplicative effects on $\hat{l}_{zt}$ from an initial increase in w_{zt}^r. The latter reinforces the incentive for aggressive wage policy. In other words, with «large» wage setters, workers are better able to take advantage of the circumstances, e.g. a higher labor demand and follow aggressive wage policy.

It is easy to show that $d\left(\frac{dw_{YY}}{dn^{-1}}\right)\Big/ d\varphi_Y < 0$: «Large» unions more internalize the negative impact of φ_Y on Σ_L (the multiplier process is smaller as less employment is induced with each round of activity, rending «*NRDIM*» lower) and consequently the positive impact on e_{L_z} (strategic interactions between fiscal policy and labor market). Also, the incentive for aggressive wage policy when n^{-1} is high, is amplified, when asset market participation is limited (big λ), because «large» unions understands that the bigger is the fraction of Non-Ricardian households, the bigger is the «*NRDIM*», and therefore Σ_L (the smaller is e_{L_z}), (strategic interactions between asset market and labor market).

Limited asset market participation

Almost the similar reasoning as for (32) stands for the impact of λ on w_{YY}, i.e. (33), since limited asset market participation (big λ) reinforces the dominant «*NRDIM*» and the multiplicative process and hence $\Sigma_L > 0$. The latter weakens e_L. Hence, limited asset market participation will induce «non-atomistic» unions to aggressive wage policy. Alternatively, since the Non-Ricardian members of the typical trade union cannot smooth consumption (income) through asset markets, it is straightforward that the bigger is λ, the more aggressive trade union's wage policy becomes – after the relevant pressures of its Non-Ricardian members.

Fiscal policy countercyclicality

The intuition for the negative impact of φ_Y on w_{YY}, i.e. (34), is the following: «Non-atomistic» wage setters take into account that when $0 < \lambda < 1$, «*NRDIM*» does not only exist but also dominates «*ISRCM*» - the higher the degree of fiscal policy countercyclicality, the lower the *multiplier* effect of a wage increase, through the dominant «*NRDIM*», on aggregate employment. So, when φ_Y is high, lower values of Σ_L lead to higher values of e_{L_z} (a wage increase is associated with big decrease in the labor demand of the representative union's members) and hence reinforce the incentives for wage moderation.

2.5 Aggregation and market clearing

Aggregate consumption and hours worked are given by $C_t = \lambda C_t^{ROT} + (1-\lambda)C_t^O$ and $L_t = \lambda L_t^{ROT} + (1-\lambda)L_t^O$. Moreover, we assume that firms will allocate labor demand uniformly across households, independently of their type, and hence, $L_t^{ROT} = L_t^o = L_t$, (Gali, 2007).

Market clearing requires that all dividends be paid to asset holders, $D_t = (1-\lambda)D_t^o$, all assets be held by asset holders, $A_t = (1-\lambda)A_t^o$, and the resource constraint to hold, $Y_t = C_t + G_t$.

Finally, we define $\rho = C/Y$. The log-linear equations are given respectively by:

$$\hat{c}_t = \lambda \hat{c}_t^{ROT} + (1-\lambda)\hat{c}_t^O \tag{35}$$

$$\hat{l}_t^{ROT} = \hat{l}_t^O = \hat{l}_t \tag{36}$$

$$\hat{y}_t = \rho \hat{c}_t + (1-\rho)\hat{g}_t \tag{37}$$

2.6 Steady state and calibration

Following Ascari et al. (2011), firms are also taxed through a constant lump-sum tax, T, which leads to zero steady state profits and consequently equalized steady state consumption levels across agents, $C^{ROT} = C^O = C$. Combining the latter with $G^{ROT} = G^O = G$ and $L^{ROT} = L^O = L$ means that, as long as the economy is on steady state, both types of households derive identical utilities.

Moreover, the tax proceedings are used by the fiscal authority to subsidise firms by means of a constant employment subsidy, μ_w, i.e., $T = \mu_w W^r L$. As a result, it can perfectly offset the steady-state distortions associated with monopolistic competition in both the labor and product markets (Rotemberg and Woodford, 1997; and Woodford, 2011). So, in our model the steady state is not only *equitable*[10] but also *efficient*. The efficient steady state hypothesis is chosen since we are not interested in endogenize i) the usual inflationary bias (caused by an inefficiently low level of steady-state output) by allowing a direct interaction of «non atomistic» unions and the fiscal authority[11], and ii) the determination of the steady state[12].

Finally, the parameters are calibrated as follows:

Table 2: Calibration

n	θ	β	λ	ϕ_Y	$\rho \equiv C/Y$	σ	ε_w	ε_P	ϕ
$n > 1$	0,75	0,99	$\lambda \in (0,1)$	$\phi_Y > 0$	0,75	0,5	7	7	2

2.7 Modified New Keynesian IS curve and Phillips curve

It is obvious that under the assumption of the existence of Non-Ricardian households, changes in the labor market impacts on current Non-Ricardian labor income, affecting Non-Ricardian consumption and hence total consumption and output. At the same time, the labour market can have important effects on the supply-side of the economy, as wage impacts directly on marginal cost and therefore on optimal price setting and inflation.

The purpose of this section is to determine how the strategic interactions between «non-atomistic» wage setters, asset market and the fiscal sector impacts on the equations describing the private sector behavior, i.e. New Keynesian IS curve (NKISC) and New Keynesian PC (NKPC). The latter, as we shall see, has interesting policy implications.

The NKPC is standard (see Gali, 2015) and is given by $\pi_t = \beta E_t \pi_{t+1} + k\left(mc_t^r + \ln \mu\right) + k\hat{\mu}_t$, where $k = (1-\theta\beta)(1-\theta)\theta^{-1}$ and $\hat{\mu}_t = \ln \mu_t - \ln \mu$. Substituting the real wage setting equation, i.e. (27), in the expression for real marginal cost, and further in the NKPC, we finally obtain:

$$\pi_t = \beta E_t \pi_{t+1} + \pi_{YY} \hat{y}_t - \pi_{GG} \hat{g}_t + k\hat{\mu}_t \tag{38}$$

Where

$$\pi_{YY} = k w_{YY} \tag{39}$$

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[10] As in Gali et al. (2004, 2007) the focus of the paper isn't on steady state differences across households.

[11] «Non atomistic» wage setters might want to influence the inflation bias of the fiscal or monetary authority through their real wage decisions, as these affect equilibrium unemployment. For the kind of interaction between «non atomistic» unions and the monetary authority, see Scott (1997); Cukierman and Lippi, (1999); Guzzo and Velasco (1999).

[12] The long-run equilibrium values of real variables are determined by labor market structure and monetary policy interactions. Gnocchi (2009) has showed that anti-inflationary monetary policy is able to control the degree of inefficiency (steady state employment), once the presence of large wage setters is taken into account. See, also, Bratsiotis and Martin (1999); Holden (2005); and Coricelli et al. (2006).

$$\pi_{GG} = kw_{GG} \tag{40}$$

On the other hand, under the hypothesis $0 < \lambda < 1$, and after proper algebraic manipulations, the NKISC is given by

$$\hat{y}_t = \mathrm{E}_t \hat{y}_{t+1} + \delta_G \hat{g}_t - \delta_G \mathrm{E}_t \hat{g}_{t+1} - \delta_R \hat{r}_t \tag{41}$$

Ceteris paribus the ability of macroeconomic (monetary and fiscal) authorities to activate countercyclical fiscal policy, (16), the elasticities of macroeconomic policy, are given respectively by

$$\frac{d\hat{y}_t}{d\hat{g}_t} = \delta_G = \frac{(1-\rho) - \rho\lambda w_{GG}}{1 - \rho\lambda(w_{YY} + 1)} \tag{42}$$

$$\frac{d\hat{y}_t}{d\hat{r}_t} = \frac{d\hat{y}_t}{d\hat{c}_t^o} \cdot \frac{d\hat{c}_t^o}{d\hat{r}_t} = -\delta_R = -\frac{\sigma\rho(1-\lambda)}{1 - \rho\lambda(w_{YY} + 1)} \tag{43}$$

It is commonly observed that, increases in government spending and reductions in interest rates lead to an increase in output/aggregate demand, all other things being equal. However, this is only true if δ_R and δ_G are positive.

Moreover, taking as given the ability of macroeconomic authorities to trigger countercyclical fiscal policy, we can distinguish three regions that describe the model: The «Standard Aggregate Demand Logic» («SADL») where $\lambda < \lambda_1^*$, the «Inverted Aggregate Demand Logic» («IADL»), where $\lambda_1^* < \lambda < \lambda_2^*$ and the «Quasi Inverted Aggregate Demand Logic» («QIADL») where $\lambda > \lambda_2^*$[13].

Table 3: Regions that describe economy, ceteris paribus the ability of macroeconomic authorities to trigger countercyclical fiscal policy

	Regions that describe economy		
	«SADL»: $\lambda < \lambda_1^*$	«IADL»: $\lambda_1^* < \lambda < \lambda_2^*$	«QIADL»: $\lambda > \lambda_2^*$
$\frac{d\hat{y}_t}{d\hat{g}_t}$	> 0	< 0	> 0
Slope of NKISC: $\frac{d\hat{y}_t}{d\hat{r}_t}$	< 0	> 0	

As it is common in the New-Keynesian model augmented with limited asset market participation, there exists a threshold parameter value of λ beyond which the slope of NKISC is reversed, from negative to positive [see Bilbiie (2005, 2008); Gali et al. (2004, 2007); Di Bartolomeo and Rossi (2005); Ascari et al. (2017)].

[13]However, for baseline parameter values, we get that $\lambda > \lambda_2^* \equiv (1-\rho)/\rho w_{GG}$ is not plausible (too high values). See Appendix 4, Table 5. So, «QIADL» is not empirical plausible.

$$\lambda_1^* \equiv \frac{1}{\rho(w_{YY}+1)} \tag{44}$$

In Table 4, we calibrated this threshold parameter value for different values of n and ϕ_Y: For plausible parameters values (Table 2), the slope of NKISC curve can be positive or negative.

Table 4: λ_1^* for different values of n and ϕ_Y

Degree of fiscal policy countercyclicality	Number of unions, n	Threshold parameter value λ_1^*
$1 \le \phi_Y < 11$	$n = 2$	$\lambda_1^* = 0{,}28$
	$3 \le n \le 11$	$\lambda_1^* = 0{,}30$
	$12 \le n \le 500$	$\lambda_1^* = 0{,}31$

In addition, the fact that w_{YY} is a determinant of the threshold parameter value λ_1^* leads us to Proposition 3.

Proposition 3

Whenever unions make more aggressive wage demands, the area where the NKISC's slope preserves its negative (positive) sign, i.e. «SADL» area («IADL» and «QIADL» area) is shrunk (extended). This is true under the prerequisites described in Proposition 2.

Finally, note that since limited asset market participation hypothesis can drastically change the slope of the NKISC, it can also change the determinacy conditions of an otherwise standard New Keynesian monetary model [see for example Gali et al. (2004), Bilbiie (2008); Di Bartolomeo and Rossi (2005); and Rossi (2014)]. Thus, Proposition 3 may have policy implications for the conditions (i.e. in terms of monetary coefficient) under which a unique and stable equilibrium exists. This issue is examined in Section 3.1

3 Modified aggregate dynamics

In this section we look at how a New-Keynesian, model with the addition of a non-Walrasian labor market solely based on «non-atomistic» unions, who take into account of countercyclical fiscal policy and the existence of Non-Ricardian households, affects: i) the conditions under which the rational expectation equilibrium is determined (Section 3.1), and ii) the responses of the main endogenous variables to a mark-up shock (Section 3.2).

To analyze these effects, we specify the following autoregressive process for the cost-push shock in the NKPC, (38), where the innovation ε_t^μ is assumed to be i.i.d. standard normal process. The cost push shock is assumed to persistent ($\rho^\mu = 0{,}5$) with a standard deviation of 0.005 (Ireland, 2004; Woodford, 2011).

$$\hat{\mu}_t = \rho^{\mu} \hat{\mu}_{t-1} + \varepsilon_t^{\mu} \tag{45}$$

Thus, the NKPC and NKISC, (38) and (41), together with the feedback policy rules (15) and (16), fully determine the dynamics of endogenous variables as a function of exogenous shocks.

At this point it should be noted that, the assumption of fiscal policy countercyclicality (with respect to output) generates an endogenous mechanism according to which macroeconomic authorities are able to trigger the reaction of the fiscal authority to their decisions.

In particular, in our setting, the ability of monetary authority to activate countercyclical fiscal policy, creates an additional monetary transmission channel, i.e. $(1+\delta_G \phi_Y)^{-1}$: Changes in $\hat{r}_t$ impacts on $\hat{y}_t$. But the story does not end here, as the latter affects - through the fiscal policy rule - $\hat{g}_t$ and hence, through the NKISC, $\hat{y}_t$, etc. For baseline parameter values, $(1+\delta_G \phi_Y)^{-1}$ could be either positive or negative: It is straightforward to show that it is positive for $\lambda < \lambda_1^*$ («SADL») and $\lambda > \lambda_3^*$ («IADL-2» and «QIADL»), and negative for $\lambda_1^* < \lambda < \lambda_3^*$ («IADL-1»), with $\lambda_3^* < \lambda_2^*$. The above observations have interesting implications for the (sign of the) slope of the NKISC (see Proposition 4a and Table 5).

Formally, these can be shown by substituting the fiscal policy rule, (16) into the NKISC, (41). The relevant slope is now equal to:

$$\frac{d\hat{y}_t}{d\hat{r}_t} = -\delta_{RG} \equiv -\delta_R (1+\delta_G \phi_Y)^{-1} > or < 0 \tag{46}$$

<u>Proposition 4</u>

a) Under limited asset market participation hypothesis, the ability of monetary authority to activate countercyclical fiscal policy, extends (shrinks) the area where the NKISC preserves its negative (positive) sign. This can be shown by comparing Table 5 with Table 3.

b) The slope of the NKISC, depends on the aggressiveness of the unions' wage claims. In particular, when the NKISC has a negative slope, [i.e. for $\lambda < \lambda_1^*$ and $\lambda_1^* < \lambda < \lambda_3^*$ - «SADL» and «IADL-1» regions], as w_{YY} increases (see Proposition 2), the sensitivity of aggregate demand to interest rates increases in absolute value, making policy more effective in containing demand (larger volatility of the output gap). The opposite holds for the area where the NKISC is positively sloped.

Table 5: Slope of the NKISC, when the monetary authority triggers countercyclical fiscal policy

	Slope of the NKISC, when the monetary authority triggers countercyclical fiscal policy			
	«SADL»: $\lambda < \lambda_1^*$	«IADL-1»: $\lambda_1^* < \lambda < \lambda_3^*$	«IADL-2»: $\lambda_3^* < \lambda < \lambda_2^*$	«QIADL»: $\lambda > \lambda_2^*$

$\frac{d\hat{y}_t}{d\hat{r}_t} = -\delta_{RG}$	< 0	> 0

On the other hand, after proper substitutions, the slope of NKPC is now given by:

$$\frac{d\pi_t}{d\hat{y}_t} = \pi_{YG} \equiv \pi_{YY} + \pi_{GG}\phi_Y > 0 \tag{47}$$

Proposition 5

The slope of the NKPC depends positively not only on the incentive for aggressive wage claims, i.e larger values of w_{YY} (see prerequisites described in Proposition 2), but also on the degree of activation of countercyclical fiscal policy, per se, (i.e ϕ_Y).

Propositions 4 and 5 have important implications for the dynamics of the model and the optimal monetary policy (see next sections).

3.1 Determinacy of the REE

To assess the determinacy of the REE, we substitute the feedback policy rules into NKPC and NKISC and then write the model in the matrix form $AE_t z_{t+1} = Bz_t + \Omega\psi_t$, where z_t is the 2x1 vector of the endogenous variables which are non-predetermined $z_t = \lfloor \hat{y}_t, \pi_t \rfloor'$, $\psi_t = \hat{\mu}_t$ is the 1x1 vector of the exogenous disturbances. The 2x2 square matrices of the coefficients are defined as $A \equiv \begin{bmatrix} 1+\delta_G\phi_Y & \delta_R \\ 0 & \beta \end{bmatrix}$, $B \equiv \begin{bmatrix} 1+\delta_G\phi_Y & \delta_R\phi_\Pi \\ -\pi_{YG} & 1 \end{bmatrix}$ and $\Omega \equiv \begin{bmatrix} 0 \\ -k \end{bmatrix}$. Since, under baseline calibration, matrix A is invertible, we get that $E_t z_{t+1} = A^{-1}Bz_t + A^{-1}\Omega\psi_t = \Gamma z_t + \Psi\psi_t$. For determinacy, the number of eigenvalues of Γ outside the unit circle must equal the number of non-predetermined endogenous variables, Blanchard and Kahn (1980). In our case there are two non-predetermined endogenous variables. Following Woodford (2011), the necessary and sufficient conditions for determinacy are presented in Proposition 6.

Proposition 6

a) When NKISC has a negative slope $(\delta_{RG} > 0)$, i.e. for $\lambda < \lambda_3^*$ («SADL» and «IADL-1» regions), the equilibrium is locally unique, when in terms of the monetary coefficient it must be the case that (necessary and sufficient conditions)

$$\phi_\Pi \in (1, \infty) \tag{48}$$

b) Otherwise, i.e. for $\lambda > \lambda_3^*$ («IADL-2» and «QIADL» regions), it is required that

$$\phi_\Pi \in [(0, \min\{\phi_4, 1\}) \cup (\max\{1, \phi_6\}, \infty)] \tag{49}$$

So, as in standard New-Keynesian model with current-looking interest rate rule, monetary policy should be «active» and follow the standard «Taylor Principle», with no lower bound, when the slope of NKISC is negative. For $\lambda < \lambda_3^*$ the determinacy region does not depend on structural parameters of the model.

This stops being true when the slope is reversed. In this case there are two determinacy regions: In the first determinacy space, monetary authority has to be «passive» and follow the «Inverted Taylor Principle». This conduct may have an upper limit represented by $\phi_4 \equiv (1-\beta) \Big/ \pi_{YG} \overbrace{(-\delta_{RG})}^{>0}$. In the second one, monetary authority has to be «active» with a potential lower limit represented by $\phi_6 \equiv \dfrac{2(1+\beta)}{(\pi_{YG})\underbrace{(-\delta_{RG})}_{>0}} - 1$. In both cases, these limits are negative functions of the unions' incentive for aggressive wage claims, i.e. when the prerequisites described in Proposition 2 are valid.

3.2 Impulse response functions

In an augmented DSGE New-Keynesian model with limited asset market participation, labor market characteristics influence the dynamics of real wages and thus the dynamics of Non-Ricardian consumption and hence of output. Hence it seems natural to assess the quantitative relevance of such institutions in determining differentials in output and inflation behavior.

In doing so, we look at the implied dynamics of the main economic variables in response to a cost-push shock. In what follows, we restrict our analysis in «SADL» and «IADL-1» regions of the economy, where the NKISC is negatively sloped.

In particular, we analyze how the dynamics of the baseline model depends on the strategic interactions between «non-atomistic» unions, countercyclical fiscal policy and the asset markets. In order to highlight the implications of unions' incentive to moderate wage claims or not, we conduct a sensitivity analysis by varying the values of ϕ_{Υ}, n and λ. This way, we assess the importance of institutions by explaining the volatility of output and inflation.

Analytical expressions for the responses of $\hat{y}_t$ π_t, $\hat{r}_t$ and $\hat{i}_t$ to the cost-push shock, under the baseline model, are derived as:

$\hat{y}_t = -\left[1-\Theta\left(1-\beta\rho_\mu\right)\right]\hat{u}_t / \pi_{YG}, \pi_t = k\Theta\hat{u}_t$, $\quad \hat{r}_t = \left[1-\left(1-\beta\rho_\mu\right)\Theta\right]\left(1-\rho_\mu\right)\hat{u}_t / \delta_{RG}\pi_{YG}$, and $\hat{i}_t = \left\{\left[\left(1-\left(1-\beta\rho_\mu\right)\Theta\right)\left(1-\rho_\mu\right) / \delta_{RG}\pi_{YG}\right] + k\Theta\rho_\mu\right\}\hat{u}_t$, where

$$\Theta \equiv \left[\frac{k\pi_{YG}\delta_{RG}\left(\phi_\Pi - \rho_\mu\right)}{\left(1-\rho_\mu\right)} + \left(1-\beta\rho_\mu\right)\right]^{-1} \tag{50}$$

Finally, note that:

$$\frac{d\Theta}{dw_{YY}} < 0$$

As long as the NKISC is negatively sloped, if the Blanchard-Kahn condition, i.e. (49), is satisfied, then $0 < \Theta < \frac{1}{(1-\beta\rho_{\mu})}$. An exogenous increase in the cost push shock leads to an increase in inflation, nominal interest rate and real interest rate and a fall in output gap.

Figure 1 depicts the impulse response functions of key variables for the baseline model under two scenarios. According to the first, we set $\phi_{Y} = 2$, $n = 25$ and $\lambda = 0{,}2$, which implies that «non-atomistic» unions have an incentive to moderate wages claims, while in the second scenario, we have $\phi_{Y} = 1$, $n = 3$ and $\lambda = 0{,}3$ (aggressive wage policy).

In line with the theoretical predictions, it is quite evident from the impulse response functions, that in response to a cost push shock, the rise in inflation is less pronounced and the fall of output higher, whenever the incentive to aggressive wage claims is higher, i.e. for high degree of fiscal policy countercyclicality, φ_Y, or/and low degree of central wage setting, n^{-1}, and limited asset market participation, λ.

The intuition is the following: An exogenous supply shock moves inflation off the target and it forces monetary authority to react by setting the nominal interest rate – according to «Taylor Principle» - so to influence the real interest rate and the output gap in order to return inflation to its targets. In other words, the monetary authority engineers a recession to return inflation to its target (zero), via the NKPC. The larger is w_{YY} - the more aggressive are unions' wage claims – the more effective is monetary policy in «SADL» and «IADL-1» regions of the economy (see Proposition 4b). So, the recession might be deeper (i.e., larger volatility of the output gap), but inflationary phase is milder (smaller volatility of the inflation).

It is well known that a cost-push triggers an inflation/output gap volatility trade-off (Clarida et al. 1999)[14]. Formally, in our model the closed-form solutions for the unconditional volatilities, $\sigma^2_{Y}, \sigma^2_{\Pi}$, are equal to:

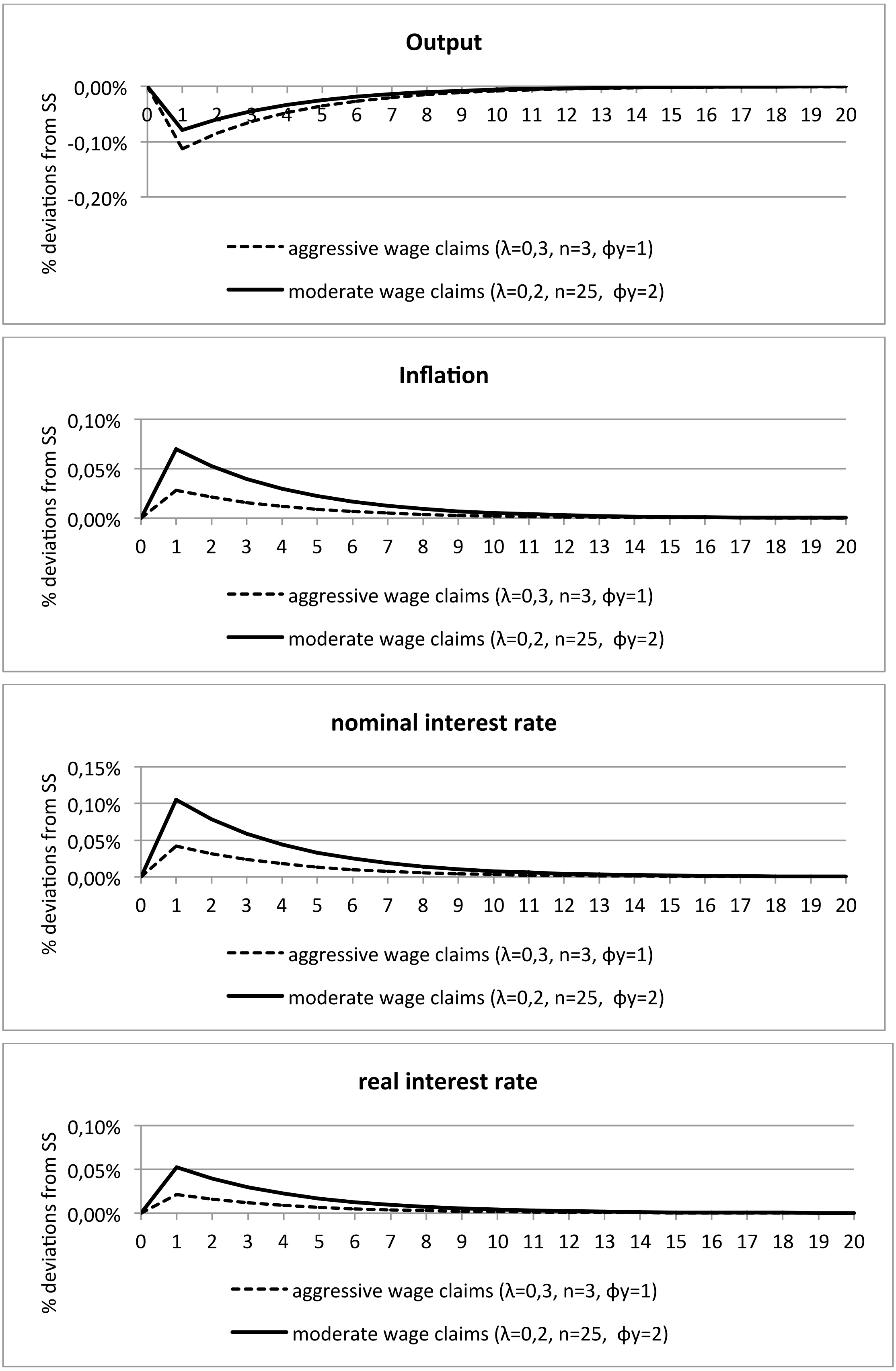
$$\sigma^2_{\Pi} = (k\Theta)^2 \sigma^2_{\mu} \tag{51}$$

$$\sigma^2_{Y} = \left[\frac{1-\Theta(1-\beta\rho_{\mu})}{\pi_{YG}}\right]^2 \sigma^2_{\mu} \tag{52}$$

So, conditional on the cost push shock, the impact of w_{YY} on σ^2_{Π}, is decreasing, i.e. $\frac{d\sigma^2_{\Pi}}{dw_{YY}} < 0$, while the opposite its true for σ^2_{Y} , since $\frac{d\sigma^2_{Y}}{dw_{YY}} > 0$.

Figure 1: Impulse response functions to a cost-push shock, for $\varphi_Y = \{0, 1, 1.5, 2\}$

[14] See also Section 4.



Note: We consider the baseline parameterization (Section 2.6) for the other parameters.

4. Optimal monetary policy

In this section our task is to characterize optimal monetary policy a) in the presence of strategic interactions between large wage setters, countercyclical fiscal policy and asset markets, for example «Social Pacts», and, b) when monetary policy is able to activate countercyclical fiscal policy.

As Clarida et al. (1999), we focus only on the discretionary solution to the central banker's problem, and not fully optimal (commitment), as this case can be argued to be more realistic in practice. With endogenous fiscal policy, e.g. (16), the policy problem consists of choosing a path $\left\{i_t^g\right\}_0^\infty$ that minimizes the social loss function[15,16]

$$H = -\frac{Yu_C\varepsilon\theta}{2(1-\theta)(1-\beta\theta)}E_t\sum_t^\infty\beta^t\left[\alpha_C\left(\frac{1}{\rho}y_t^g-\frac{(1-\rho)}{\rho}g_t^g\right)^2+\alpha_G\left(g_t^g\right)^2+\alpha_Y\left(y_t^g\right)^2+\left(\pi_t\right)^2\right]+t.i.p \quad (53)$$

subject to the NKISC, (41), NKPC, (38), and the fiscal policy rule, (16).

The index «g» denotes the usual «gap» form[17], and the weights attached to each element are a function of deep model parameters: $\alpha_C = k\rho/\varepsilon\sigma$, $\alpha_G = k(1-\rho)/\varepsilon\sigma$, and $\alpha_Y = k/\varepsilon\phi$. For consistency with the determinacy analysis in section 3.1, we reduce the dynamic system by one dimension, by substituting (16) into (53),(41) and (38).

Solving this problem, we find that the central bank adjusts its instrument in order to ensure that the following targeting rule under discretion hold at all times:

$$y_t^g = -\frac{\pi_{YG}}{\alpha_{CYG,\phi_y}}\pi_t \quad (54)$$

where

$$\alpha_{CYG,\phi_y} \equiv \alpha_C\left[\left(1+(1-\rho)\phi_Y\right)\rho^{-1}\right]^2+\left(\alpha_G\phi_Y{}^2+\alpha_Y\right)>0 \quad (55)$$

Condition (54) implies that the central bank pursue a «*Lean against the wind*» policy (Clarida et al. 1999; Woodford, 2011; and Walsh 2017): Whenever inflation is above target, e.g. due to a cost-push shock, contract demand below efficiency - output must fall below its efficient level (by raising the interest rate); and vice-versa when it is below target.

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[15] In order to derive this welfare function we proceed in the following manner. Firstly, we consider the social planner's problem. We then contrast this with the outcome under flexible prices in order to determine the level of the steady-state subsidy required to ensure the model's initial steady-state is socially optimal. Finally, following Woodford (2011), we use a second-order approximation to a convex combination of households' utilities in order to assesses the extent to which endogenous variables differ from the efficient equilibrium, due to the nominal inertia present in the model. Finally, under the hypothesis of *efficient* and *equitable* steady state and using a second-order approximation to (35) and (37), the aggregate welfare function can be approximated by (53).

[16] Where terms independent of policy (t.i.p) and terms of order higher than two have been ignored.

[17] That is the difference between actual and efficient levels, $x_t^g \equiv \hat{x}_t - \hat{x}_t^* = x_t - x_t^*$, as $x = x^*$.

Crucially, this trade-off depends positively on π_{YG}, and therefore positively on the incentive for aggressive wage demands. In particular, since π_{YG} is generally increasing in λ and n^{-1} and decreasing in ϕ_Y, in an economy with limited asset market participation or/and high degree of central wage bargaining and low degree of fiscal policy countercyclicality, optimal policy results in greater output gap volatility and lower inflation volatility than in a full participation economy.

For consistency with the foregoing determinacy discussion (section 3.1), we choose the current-looking form[18] for the «instrument rule» that implements (54). So,

$$i_t^g = \left[\rho^{\mu} + \frac{\pi_{YG}\left(1-\rho^{\mu}\right)\delta_{RG}^{-1}}{\alpha_{CYG,\phi_Y}}\right]\pi_t = \phi_o \pi_t \tag{56}$$

The latter observations lead us to Proposition 7.

Proposition 7

a) The policy «trade-offs» for monetary authority, implied by the cost-push shock term in the NKPC, are endogenized. «*Lean against the wind»* policy is dependent of the distortions in labor and asset markets and the degree of fiscal policy countercyclicality. This suggests the stabilization role of the institutions (e.g. «Social Pacts»), when the monetary authority is unable to commit to future policies and, therefore, in using the expectations channel to help stabilize inflation expectations.

b) When the NKISC has a negative slope $(\delta_{RG} > 0)$, i.e. for $\lambda < \lambda_3^*$ («SADL» and «IADL-1» regions), the implied instrument rule for optimal policy is always «active», $\phi_o > 1$. This is not true for $\lambda > \lambda_3^*$, as under certain circumstances, the implied instrument rule can be either «active» or passive.

5 Conclusions

In an economy where there are households that simply consume their current income, monetary policy can control price dispersion not only through the reallocation of intertemporal consumption plans, but also through the labor market. We have outlined a framework that shows how «Social Pacts», and in general, strategic interactions between «non-atomistic» unions, fiscal policy and asset markets can help monetary policy on the control of the supply side of the economy. In this paper we reveal that there is a stabilization role for labor markets with «non-atomistic» unions. Our results have clear normative implications. In a nutshell, monetary authority policy should be pursued with an eye to institutions.

Appendix 1

Table 1: Social pacts, by policy domain or issue area, 1970-2007

	All pacts	Wages	Working hours	Training	Union rights	Social security	Pensions	Tax budgets	ALMP* jobs	EPL**

[18] As equation (14).

1970-1979	22	17	0	0	4	2	2	16	4	0
1980-1989	15	15	8	1	1	2	0	10	5	2
1990-1999	34	25	8	10	8	22	8	17	19	9
2000-2007	20	14	3	12	5	14	7	9	8	6

* ALMP = Active Labour Market Policy

** EPL = Employment Protection Legislation

Source: ICTWSS Database, Visser (2009).

Appendix 2

a) $e_{L_z} < 0$ requires that $\lambda < \lambda^*_{e_L} \equiv \dfrac{\sigma\rho(1-\theta)(1-\theta\beta)+\varepsilon_w(n-1)[1+(1-\rho)\phi_Y]}{\rho[1+\sigma(1-\theta)(1-\theta\beta)+\varepsilon_w(n-1)]}$, which is true for plausible parameters' values and independently of the degree of central wage setting, i.e. $\lambda < 1{,}166 + 0{,}29\phi_Y$ (for $n = 2$) and $\lambda < 1{,}319 + 0{,}33\phi_Y$ (for $n = 15$).

b) $e_{L_z} > 1$ is true for $\lambda < \dfrac{[1+(1-\rho)\varphi_Y][\varepsilon_w(n-1)-n]+\sigma\rho(1-\theta)(1-\theta\beta)}{\rho[(n-1)(\varepsilon_w-1)+\sigma(1-\theta)(1-\theta\beta)]}$, which is empirical plausible according to the baseline parameters' values and independently of n, i.e. $\lambda < 1{,}110 + 0{,}276\varphi_Y$ (for $n = 2$) and $\lambda < 1{,}317 + 0{,}329\varphi_Y$ (for $n = 15$).

c) According to our baseline calibration and independently of the degree of concentration of the labor market, in our model we get that $\dfrac{d\hat{w}^r_t}{d\hat{g}_t} \equiv -w_{GG} < 0$: For $n = 2$ it is needed $\lambda < 0{,}89 + 0{,}219\varphi_Y$ and for $n = 15$, $\lambda < 1{,}311 + 0{,}327\varphi_Y$.

Appendix 3

By differentiating (28) we easily get:

$$\begin{aligned}\frac{dw_{YY}}{dn^{-1}} &= \frac{dw_{YY}}{dw_Y}\cdot\frac{dw_Y}{dK}\cdot\frac{dK}{de_L}\cdot\frac{de_L}{dn^{-1}} = \frac{(1+\phi)}{\phi}\cdot\left(-\frac{1}{(e_L-1)^2}\right)\cdot\overbrace{\frac{de_L}{dn^{-1}}}^{-} = \\ &= \frac{(1+\phi)}{\phi}\cdot\frac{1}{(e_L-1)^2}\cdot\left(\varepsilon_w+\frac{\lambda\rho-\sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)}{1-\lambda\rho+(1-\rho)\varphi_Y}\right) > 0\end{aligned} \tag{32}$$

The impact effect of n^{-1} on e_{L_z} is negative: For $\lambda < \lambda^* \equiv \dfrac{\varepsilon_w[1+(1-\rho)\varphi_Y]-\sigma\rho(1-\theta)(1-\theta\beta)}{\rho[\varepsilon_w-1-\sigma(1-\theta)(1-\theta\beta)]} = 1{,}558 + 0{,}39\varphi_Y$ we get that $\dfrac{de_{L_z}}{dn^{-1}} = \dfrac{\partial e_{L_z}}{\partial n^{-1}} + \dfrac{de_{L_z}}{d\Sigma_L}\cdot\dfrac{d\Sigma_L}{dn^{-1}} = -\left(\varepsilon_w + \dfrac{\lambda\rho-\sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)}{1-\lambda\rho+(1-\rho)\varphi_Y}\right) < 0$.

$$\frac{dw_{YY}}{d\lambda}=\frac{dw_{YY}}{dw_Y}\cdot\frac{dw_Y}{dK}\cdot\frac{dK}{de_L}\cdot\overbrace{\frac{de_L}{d\lambda}}^{-}=$$
$$=\frac{(1+\phi)}{\phi}\cdot\frac{1}{(e_L-1)^2}\cdot\frac{(1-\rho)[\sigma\rho(1-\theta)(1-\theta\beta)(1+\varphi_Y)+\rho\varphi_Y]+\rho}{[1-\lambda\rho+(1-\rho)\varphi_Y]^2 n}>0 \tag{33}$$

Similarly, the impact effect of λ on e_{L_z} is negative, as $\frac{de_{L_z}}{d\lambda}=\frac{de_{L_z}}{d\Sigma_L}\cdot\frac{d\Sigma_L}{d\lambda}=-\frac{(1-\rho)[\sigma\rho(1-\theta)(1-\theta\beta)(1+\varphi_Y)+\rho\varphi_Y]+\rho}{[1-\lambda\rho+(1-\rho)\varphi_Y]^2 n}<0$.

$$\frac{dw_{YY}}{d\phi_Y}=\frac{dw_{YY}}{dw_Y}\cdot\frac{dw_Y}{dK}\cdot\frac{dK}{de_L}\cdot\frac{de_L}{d\phi_Y}=\frac{(1+\phi)}{\phi}\cdot\left(-\frac{1}{(e_L-1)^2}\right)\cdot\overbrace{\frac{de_L}{d\phi_Y}}^{+}=$$
$$=-\frac{(1+\phi)}{\phi}\cdot\frac{1}{(e_L-1)^2}\cdot\frac{(1-\rho)[\lambda\rho-\sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)]}{[1-\lambda\rho+(1-\rho)\varphi_Y]^2 n}<0 \tag{34}$$

Finally, the impact effect of ϕ_Y on e_{L_z} is positive: For $\lambda>\lambda^*_{\Sigma_L}=0{,}0312$ we have that $\frac{de_{L_z}}{d\varphi_Y}=\frac{de_{L_z}}{d\Sigma_L}\cdot\frac{d\Sigma_L}{d\varphi_Y}=\frac{(1-\rho)[\lambda\rho-\sigma\rho(1-\lambda)(1-\theta)(1-\theta\beta)]}{[1-\lambda\rho+(1-\rho)\varphi_Y]^2 n}>0$

Appendix 4

Table 5: λ_2^* for different values of n and ϕ_Y

Degree of fiscal policy countercyclicality	Number of unions, n	Threshold parameter value $\lambda_2^*\equiv\frac{1-\rho}{\rho w_{GG}}$
$1\le\phi_Y<11$	$n=2$	$\lambda_2^*=0{,}99$
	$n=5$	$\lambda_2^*\approx 0{,}76$
	$n=15$	$\lambda_2^*\approx 0{,}69$
	$n=500$	$\lambda_2^*\approx 0{,}67$

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