The macroeconomics of social pacts*

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August, 2004

Abstract

In this paper we analyze macroeconomic interactions among trade unions, the central bank and the fiscal policymaker. We explicitly model trade unions' concern for public expenditure, paving the way for an analysis of the potential gains from cooperation between the fiscal policymaker and the trade unions, i.e. the so-called corporatist or social pacts that have characterized economic policies in a number of European countries in the last few decades. We also show that central bank conservatism or administrative ceilings on public expenditure may be ineffective, as tax rates and real wage claims are strategic substitutes.

1 Introduction

In this paper we analyze macroeconomic interactions among trade unions, the central bank and the fiscal policymaker. We explicitly model trade unions' concern for public expenditure, paving the way for an analysis of the potential gains from cooperation between the fiscal policymaker and the trade unions, i.e. the so-called corporatist or social pacts that have characterized economic policies in a number of European countries in the last few decades. Following Burda (1997), we define corporatism as a set of rules of the game, i.e. institutional arrangements that involve negotiation, bargaining, collaboration,

*Nicola Acocella and Giovanni Di Bartolomeo acknowledge financial support from the University of Rome "La Sapienza." Patrizio Tirelli acknowledges financial support from MIUR 60% and MIUR 40% 2003.

and accord between major economic groupings in a society, and especially between unions and governments. Thus corporatism provides the commitment technology necessary to enforce cooperative agreements between the trade-unions and the fiscal policymaker.

In their golden age (the 1970s and early 1980s) social pacts sought to trade wage moderation for higher public expenditure (namely welfare expenditure) or lower inflation (namely after the oil shocks).[1] Earlier empirical studies pointed out that corporatist economies post better performance in terms of inflation and unemployment (Bruno and Sachs, 1985; Calmfors and Driffill, 1988) but higher levels of taxation. In recent decades there have been rather conspicuous changes in European industrial relations. Since 1987, when the first of five multi-annual pacts was stipulated in Ireland, there have been numerous formal or informal agreements of a corporatist nature in practically all European countries, with the major exceptions of Belgium, France and – at least until the end of the decade – Germany. But the social pacts of the last fifteen years or so appear to differ from earlier ones in at least one important respect, since they establish reductions – rather than increases – in public expenditure and government action to protect employment and labor rights (Regini, 1997; Visser, 2002). Cooperation between governments and trade unions is thus continuing in a number of European countries and not only in those with a tradition of social-democratic government. Corporatism now has a different face, as it involves a reduction in the level of state intervention.

Theoretical analyses of macroeconomic outcomes in corporatist economies are relatively scarce. In the 1980s, Cameron (1984) and Tarantelli (1986 and 1987), among others, argued that cooperatively determined wages can ensure the same disposable income for wage earners while resulting in a higher level of employment and a lower inflation rate. Summers *et al.* (1993) pointed out that in corporatist economies interdependence between monopolistic unions and fiscal policymakers limits the distortionary effects of taxes, inducing an exchange between public expenditure increases and wage restraint. More recent contributions suggest that cooperation may improve macroeconomic performance. However the analysis is restricted to the interaction between trade-union behavior and monetary policy.[2] In this paper we revisit the case for corporatist agreements in a model where labor markets are unionized, the government controls the fiscal stance, and an independent central bank sets monetary policy. We can then analyze the scope for a political

[1] Unionized labor markets and a pervasive welfare system have long been the hallmark of European corporatist economies (OECD, 1997; Traxler and Kittel, 2000; and Rhodes, 2001).

[2] See Gylfason and Lindbeck (1994), Burda (1997), Acocella and Ciccarone (1995), Acocella and Di Bartolomeo (2004), Acocella *et al.* (2004), and Di Bartolomeo (2004).

exchange between public expenditure and wage setting choices, showing that corporatism may generate quite different macroeconomic outcomes from the traditional exchange between wage restraint and high public expenditure. In fact our model can easily encompass both first and second-generation corporatist agreements.

Our approach stands in sharp contrast with those in the literature on macroeconomic policy games, where the importance of institutional arrangements in shaping macroeconomic outcomes is a key ingredient, but the focus is restricted to institutional constraints on policymakers. Typically, central bank conservatism and institutional constraints on fiscal discretion are deemed to enhance macroeconomic efficiency, i.e. to produce lower output distortions and inflation. For instance, Beetsma and Bovenberg, 1998, implicitly or explicitly assume a given labor market performance and neglect interactions between this market and fiscal and monetary policies. Some analyses do in fact endogenize trade-union behavior but focus on monetary policy as the sole tool available for stabilization purposes. Contributions in this vein emphasize that the central banker's idiosyncratic preferences, either conservative or populist, can have a whipping effect on union behavior, thus inducing a reduction in output distortions.[3] In the paper we show that in unionized economies attempts to reduce fiscal distortions either through central bank conservatism or by imposing institutional constraints directly on the fiscal policymaker may be ineffective, as the potential output benefits from fiscal discipline are offset by higher increased real wages.

The paper is organized as follows. In section 2 we present our model and derive the equilibrium values of the relevant variables. In section 3 we compare the outcomes of cooperative and non-cooperative regimes and derive a number of propositions on the superiority of corporatism. Section 4 concludes.

2 The model

To start with, we model the production function of the representative firm: $Y = L^{\eta}$, where L is labor (Alesina and Tabellini, 1987; Beetsma and Bovenberg, 1998). The firm maximizes net profits: $PL^{\eta}(1-t) - WL$, where P is the price level, W and t are the wage and the tax rate respectively. After straightforward manipulations[4] we obtain the following expression

$$x = \pi - \pi^{e} - t - \tilde{x} \tag{1}$$

[3] See Cukierman (2004) for a review.

[4] For a derivation of equation (1), see the Appendix A.

where output deviations from the competitive non-distortionary baseline level, x, are caused by tax distortions, real wage distortions due to monopolistic unions, $\tilde{x}$,[5] and inflation surprises, $\pi - \pi^e$ (π^e defines inflation expectations).

In this economy there are three players: the government, the monopoly trade union, and the central bank.

The government's loss function is defined over inflation, output and public expenditure deviations from the target, $g - \tilde{g}$:

$$G = \frac{1}{2}\left\{\alpha_{\pi f}\pi^2 + x^2 + \alpha_{gf}\left(g - \tilde{g}\right)^2\right\} \tag{2}$$

As in Debelle and Fischer (1994), $\tilde{g}$ is interpreted as the optimal share of non-distortionary output to be spent on public goods if non-distortionary lump-sum taxes were available. In setting the public expenditures level, the government faces a balanced budget constraint:[6]

$$g = t \tag{3}$$

The trade union's loss function is

$$U \;=\; -\tilde{x}\beta_{\tilde{x}} + \;\frac{x^2}{2}\; + \;\frac{\beta_{gu}(g - \tilde{g})^2}{2} \tag{4}$$

The union's welfare increases with the real wage but falls with output distortions (see Cukierman, 2004, for an extensive survey of the literature). The assumption that the trade union is concerned with expenditure deviations from the target is perhaps less straightforward and requires some discussion. In fact union members may be concerned with specific components of public expenditures, such as pension funds, training schemes, unemployment benefits, health insurance for workers, social policies, labor policy, and any government action in the area of income distribution. We assume that the monopolistic union sets the labor market distortion, i.e. a real-wage mark-up over the competitive rate. The loss functions (2) and (4) will differ insofar as the government takes the preferences of non-workers into account (as in Beetsma and Bovenberg, 1998).[7]

[5] More precisely, $\widetilde{x}$ is defined as the real wage mark-up over the competitive wage rate, which is exogenously given (see Appendix A).

[6] For the sake of simplicity we do not consider either the seigniorage component of the budget or debt service payments.

[7] For the sake of simplicity we assume that the public expenditure targets in eq. (2) and (4) are identical.

Monetary policy is delegated to an independent central bank (CB henceforth), which is interested in minimizing both the inflation rate and output deviations from a non-distortionary equilibrium.

$$V = \frac{1}{2}\left\{\alpha_{\pi m}\pi^2 + x^2\right\} \tag{5}$$

where $\alpha_{\pi m} > \alpha_{\pi f}$. We assume that the CB directly controls the inflation rate.

3 The non-cooperative solution

The timing of the game is as follows. The union and the government simultaneously set labor and tax distortions. After that, the CB chooses monetary policy. The model is solved by backward induction. In Appendix C we extend our results to the case where the government action follows the union wage-setting decision. A graphical characterization of the Stackelberg equilibrium is provided in figures 1 and 2 below.

The CB's reaction function is easily derived from equation (5)

$$\pi = \frac{1}{1+\alpha_{\pi m}}\left\{\pi^e + t + \tilde{x}\right\} \tag{6}$$

Taking account of the balanced budget constraint (3) the government first order condition is

$$\alpha_{\pi f}(\pi)\frac{\partial \pi}{\partial t} + x_i\left(\frac{\partial x}{\partial t} + \frac{\partial x}{\partial \pi}\frac{\partial \pi}{\partial t}\right) + \alpha_{gf}(g - \tilde{g}) = 0 \tag{7}$$

where $\frac{\partial x}{\partial t} + \frac{\partial x}{\partial \pi}\frac{\partial \pi}{\partial t} = -1 + \frac{1}{(1+\alpha_{\pi m})}$

The government anticipates the CB's reaction to its tax policy, such that inflation will increase following a rise in the tax rate. However, the government cannot internalize the adverse effect of taxation on expectations, as in Beetsma and Bovenberg (1998). Hence taxes will be set *as if* the inflation response could partly offset output distortions. Furthermore, the government cannot internalize the trade-union reaction to his tax policy.

From equation (4), minimized with respect to the real wage mark-up,[8] we obtain the trade-union first order condition:

$$-\beta_{\tilde{x}} - x \ = 0 \tag{8}$$

[8] Correspondingly, the nominal wage rate, $\ln(W) = \widetilde{x} + \pi^e$, will incorporate the expectation of π.

Although the union has a public expenditure target, the real wage is set conditionally only on its direct impact on the level of output.

By imposing the rational expectations constraint, $\pi = \pi^e$, we are able to solve the model

$$x^N = -\beta_{\tilde{x}} \tag{9}$$

$$\tilde{x}^N = \beta_{\tilde{x}}\left[1 + \frac{1}{\alpha_{gf}}\left(\frac{\alpha_{\pi f} + \alpha_{\pi m}^2}{\alpha_{\pi m} + \alpha_{\pi m}^2}\right)\right] - \tilde{g} \tag{10}$$

$$\left(\tilde{g} - g^N\right) = \frac{\beta_{\tilde{x}}}{\alpha_{gf}}\left(\frac{\alpha_{\pi f} + \alpha_{\pi m}^2}{\alpha_{\pi m} + \alpha_{\pi m}^2}\right) \tag{11}$$

$$\pi^N = \frac{\beta_{\tilde{x}}}{\alpha_{\pi m}} \tag{12}$$

Output distortions are policy invariant (see eq. (9)): given the tax rate, the trade union will set the real wage distortion at a level such that (8) holds. As a consequence, labor and tax distortions are complete substitutes: the output effect of a tax change is fully offset by a real wage adjustment in the opposite direction (see eq. (10)). The more the union is concerned with the real wage objective, the lower the tax rate (eq. 11). In fact we cannot rule out the case where the government chooses to subsidize production ($g^N < 0$). Our results stand in sharp contrast with those obtained in models where labor market distortions are exogenous. First of all, production subsidies are often seen as a remedy to labor market distortions in models that treat such distortions as exogenous (Alesina and Tabellini, 1987; Dixit and Lambertini, 2003). In fact our model shows that instead of raising production the subsidy would trigger a real wage increase. Second, the expenditure bias identified in Beetsma and Bovenberg (1998) has no impact on output distortions, which are independent of fiscal policy.

3.1 The cooperative solution

Non-cooperation implies three sources of inefficiency related to the timing of the game and the existence of externalities. First, the government cannot internalize the impact of its actions on inflation expectations. Second, the government does not internalize the real wage reaction to its tax policy, such that in equilibrium $\frac{\partial x}{\partial t} = 0$. Third, the trade union neglects the adverse effects of its actions on the level of public expenditure.

As usual, cooperation is defined as the joint minimization of a convex combination of the difference between the two players' loss functions and their outside options, i.e. the generalized Nash product $\left(G - G^N\right)^{\phi}\left(U - U^N\right)^{(1-\phi)}$ with $\phi \in [0, 1]$. For our purposes, a graphical analysis is exhaustive. Before

analyzing the cooperative solution, it is useful to identify the two players' preferred combinations of expenditure gap and output. For the government, these are:[9]

$$\left(\tilde{g} - g^{GSB}\right) = \frac{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right) + \alpha_{\pi f}}{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right)\left(1 + \alpha_{gf}\right) + \alpha_{\pi f}}\tilde{g} \tag{13}$$

$$x^{GSB} = -\frac{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right)\alpha_{gf}}{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right)\left(1 + \alpha_{gf}\right) + \alpha_{\pi f}}\tilde{g} \tag{14}$$

Conditions (13) and (14) imply that $\widetilde{x} = 0$. Moreover, they are obtained by requiring the policymaker to take into account the adverse effect of taxes on inflation expectations.

The trade union's preferred combinations of expenditure gap and output are:

$$\left(\tilde{g} - g^{USB}\right) = \frac{\beta_{\tilde{x}}}{\beta_{gu}} \tag{15}$$

$$x^{USB} = x^{N} = -\beta_{\tilde{x}} \tag{16}$$

g^{USB} is determined by the union desired trade-off between public expenditures and the real wage.

There is no obvious ranking of the alternative combinations of output and expenditure gap $\left[x^{GSB}, \left(\widetilde{g} - g^{GSB}\right)\right]$, $\left[x^{USB}, \left(\tilde{g} - g^{USB}\right)\right]$, $\left[x^{N}, \left(\tilde{g} - g^{N}\right)\right]$. We consider only the following cases:[10]

$$\left(\tilde{g} - g^{USB}\right) < \left(\tilde{g} - g^{N}\right) \tag{17}$$

$$\left(\tilde{g} - g^{N}\right) < \left(\tilde{g} - g^{USB}\right) \tag{18}$$

irrespectively of the relative size of g^{GSB}. In fact, from our discussion it will be intuitively clear that a complete taxonomy would add no further insight.

If condition (17) holds, both the government and the union benefit from $\left(\widetilde{g} - g^{C}\right) < \left(\tilde{g} - g^{N}\right)$, where superscript C identifies cooperative outcomes. In figure 1, the loci RG and RU identify the two players' reaction functions, and points Σ, Ω define the outcomes[11] preferred by the government and the trade union respectively. Hence points N and S respectively identify the Nash

[9] See Appendix B for a derivation.

[10] Both conditions (17) and (18) imply $x^{GSB} > x^{N}$.

[11] Note that point Σ must lie above the locus RG. This is because, for any level of output distortions, the government internalizes the adverse effect of taxes on inflation expectations and chooses a lower level of public expenditure (see the appendix for a discussion).

and Stackelberg equilibria. It is worth noting with regard to the Stackelberg equilibrium that in this case the trade-union policy will internalize the trade off between the real wage mark-up and public expenditure.[12]

Cooperative equilibria lie within the *feasibility set*, along the C_uC_g segment of the contract curve.[13] Cooperation entails a reduction in both output distortions and the public expenditure gap. This, in turn, implies that the trade union is willing to discipline wage claims in order to benefit from an increase in expenditure.

Figure 1

By contrast, when condition (18) holds, cooperation entails a larger expenditure gap and a reduction in output distortions. In this case the trade union benefits from a real wage increase, but such increase is sufficiently moderate to leave the government better off despite the fall in expenditures (see figure 2).

Figure 2

Summarizing, our model is consistent with both the old and new forms of social pact. If $\left(\tilde{g} - g^{USB}\right) < \left(\tilde{g} - g^{N}\right)$ the government will agree to reduce the public expenditure gap (i.e., it will raise public expenditure) in exchange for wage moderation as in the *golden age* social pacts mentioned in the introduction. By contrast, if $\left(\tilde{g} - g^{USB}\right) > \left(\tilde{g} - g^{N}\right)$ the government agrees for a moderate wage rise in exchange for an increase in the public expenditure gap, i.e., a reduction in taxation. The former outcome is consistent with the first generation of social pacts (those of the 1970s). The latter seems to be in line with the second generation of social pacts (from the 1990s).

3.2 Political shifts

In section 3.1 we characterized the possible cooperative solutions conditional on the sign of $g^N - g^{USB}$. For instance, when non cooperation results in public expenditure above the trade union's preferred level, the cooperative solution entails a reduction in public expenditure and an increase in the wage rate. The result holds for any level of g^{GSB}. Here, we discuss the consequences of changes in $g^{GSB} - \tilde{g}$ due to variations in α_{gf}. This enables us to discuss

[12] Note that, due to the Beetsma and Bovenberg effect on tax policy, the CB's preferences ($\alpha_{\pi m}$), which affect the slope of the government reaction function, also affect the output distortion. The government reaction function is described in Appendix B.

[13] In this case we consider the Nash non-cooperative equilibrium as the outside option of the players in the cooperative Nash solution. In the Stackelberg case, the feasibility set has to be computed by considering a different outside option.

the impact of the political cycle on the nature of social pacts between the policymaker and the union.

A fall in α_{gf}, i.e. a political shift to the right, produces an increase in both $\tilde{g} - g^{GSB}$ and in the slope of the government reaction function RG (see Appendix B). Figure 3 describes a polarized system, where a political shift reverses the nature of the *exchange* that characterizes the cooperative solution. Points N^{LW} and N^{RW} describe Nash equilibria under left- and right-wing parties, respectively, for given trade union preferences. Cooperation between the right-wing government and the union involves a traditional exchange between wage restraint and public expenditure laxitysm. By contrast, cooperation between the left-wing government and the union entails a reduction in public expenditure and a real wage increase.

The level of public expenditure is, however, still higher under a left-wing government, thus confirming a central tenet of the political economy literature, i.e. public expenditure is systematically higher under left-wing governments.

Figure 3

Observe that in figure 3 we characterize a situation where N^{LW} entails an expenditure gap $\tilde{g} - g^{N}_{LW} > \tilde{g} - g^{GSB}_{LW}$, which implies that the left-wing government will accept a further decrease in expenditure in exchange for an increase in macroeconomic efficiency. This rationalizes the apparent paradox in the behavior of left-wing governments, which are sometimes criticized for committing to policy agreements that seems to betray their fundamental (ideological) values.

3.3 The dangers of unilateral fiscal retrenchments

In a number of papers[14] institutional constraints on the fiscal stance are shown unambiguously to improve macroeconomic performance. In these contributions trade unions' behavior is usually neglected or assumed to be exogenous. Such an assumption is not innocuous. Consider a Nash equilibrium: from equation (10) it is easy to see that administrative ceilings on the level of public expenditure,[15] as envisaged in Alesina and Perotti (1997), would subsidize the real wage, leaving output distortions unaffected. Therefore fiscal constraints always reduce welfare.

[14] See, among others, Chari and Kehoe (1997), Beetsma and Bovenberg (1998, 2000, 2002), Beetsma and Uhlig (1999), Dixit (2001), Dixit and Lambertini (2001), and Governatori and Eijffinger (2003).

[15] A number of countries have adopted expenditure targets (see Danninger, 2002, for an extensive discussion).

A more complex picture emerges if one considers the case where unions act as a leader vis à vis the fiscal policymaker (figure 4). The ceiling now introduces a commitment to set the expenditure gap, $\tilde{g} - g$, above or equal to a certain value G. It establishes a floor for the government's reaction function, and hence, for the fiscal constraint the union faces in solving its problem.

Figure 4

First, consider the case of an S_1-type equilibrium. Define the corresponding expenditure gap as $\tilde{g} - g^{S_1}$. Any $G < \tilde{g} - g^{S_1}$ would not bind. For any $G > \tilde{g} - g^{S_1}$ the binding constraint would be counterproductive: output distortion would rise to the Nash equilibrium level. This would happen because under a ceiling the trade off between wage distortion and the public expenditure gap disappears. As a consequence, the union is induced to choose a real wage mark up such that $x = -\beta_{\tilde{x}}$ for any given expenditure gap.

Second, consider an S_2-type equilibrium. For any $G > \tilde{g} - g^{S_2}$ output distortions would fall to the Nash equilibrium level. Thus, the optimally binding ceiling should entail a marginal increase in the expenditure gap. However, a commitment to *raise* expenditures would exert an identical disciplining effect on the union, but with a lower expenditure gap! In fact, the optimal constraint is a ceiling on G. The *RG-RC* line highlights the beneficial consequences of a "reversed ceiling" such that $g \geqslant g_N$. In this case the fiscal commitment replicates the N equilibrium, mimicking the cooperative solution that would exchange higher public expenditure for lower output distortion.

4 Concluding remarks

In this paper, we have endogenized the trade union's behavior and shown that policy prescriptions deriving from traditional models are ineffective with regard to output distortions. The first key to our results lies in the consideration that, in addition to the traditional objectives, i.e. the real wage rate and employment, unions may be interested in the level of public expenditure. The second key lies in our re-examination of corporatism as a feasible set of institutional arrangements designed to internalize certain negative macroeconomic externalities and to provide a positive solution to them as an alternative to the punishment suggested by much of the previous literature. The third key is the characterization of the government budget as a two-faced Janus, i.e. in its double role of providing public expenditure valuable for union members and extracting distortionary taxes. This characterization of the budget makes our model consistent with the observed evolution of

social pacts in recent decades, which appear to move from an exchange between wage moderation and higher public expenditure to one between wage moderation and lower public expenditure.

Our analysis has significant implications for the current debate on institutional reforms in Europe. Discussion of the reform of the Stability and Growth Pact fails to consider its impact on labor market performance. Our paper suggests that when the interdependence between fiscal policy and the labor market is considered, any strategy of placing an outside cap on public expenditure is doomed to be counterproductive. In one case a commitment to raise expenditures would even be preferable to a restrictive ceiling! By contrast, corporatist institutions should be regarded as valuable tools in enhancing macroeconomic performance, in line with the Lisbon Strategy approach, which emphasizes the role of social partnership.

Some authors see the commitment to fiscal restraint as a catalyst for labor market reforms that should reduce the power of unions. In this vein, the complete liberalization of the labor market would be a complementary solution to the Stability and Growth Pact. However, the risks should be clear. On the one hand, the Calmfors and Driffill hump-shaped curve (1998) suggests that corporatist agreements are likely to dominate partial labor market liberalization. On the other hand, complete decentralization may be politically unfeasible.

Appendix A – Output function

The representative price-taking firm maximizes its net profit:

$$P\left(1-t\right)Y - WL$$

subject to the technology constraint $Y = L^a$.

The first order (log)-condition is:

$$\frac{a}{1-a}\left(\ln a + p - w - t\right) = y$$

Lowercases are logs. Hence:

$$y = \frac{a}{1-a}\left(p - w - t\right) + \frac{a}{1-a}\ln a$$

Without loss of generality we assume that full-employment real output is $\bar{y} = \frac{a}{1-a}\ln a$ and we can rewrite the above equation as:

$$x = \frac{a}{1-a}\left(p - w - t\right)$$

where $x = y - \bar{y}$ is the real output gap.

By assuming that the union determines the real distortion $\tilde{x} = w - p$ with a possible forecasting error equal to $\pi - \pi^e$,[16] the above equation can be rewritten as:

$$x = \frac{a}{1-a}\left(\pi - \pi^e - t - \tilde{x}\right)$$

As usual, for the sake of exposition, in the main text we consider the following equation as Phillips curve:

$$x = \pi - \pi^e - t - \tilde{x}$$

that has the same properties of the previous one.

Appendix B – Figure outcomes

In this appendix we derive the iso-losses and reaction functions depicted in the figures (i.e. in the space $(x, g - \tilde{g})$).

The union's reaction function is derived from equation (8) in the text. The iso-loss curves are directly obtained from equation (4) by using (1):

$$U \;=\; \beta_{\tilde{x}}\left(x + g\right) + \;\frac{x^2}{2} \;+\; \frac{\beta_{gu}(g \;-\; \widetilde{g})^2}{2}$$

The government's reaction function is:

$$g - \tilde{g} = -\frac{\alpha_{\pi f} + \alpha_{\pi m}^2}{\left(1 + \alpha_{\pi m}\right)\alpha_{\pi m}\alpha_{gf}}x$$

and its iso-loss is:

$$G(x, g - \tilde{g}) = \frac{1}{2}\left\{\left(\frac{\alpha_{\pi f}}{\alpha_{\pi m}^2} + 1\right)x^2 + \alpha_{gf}\left(g - \tilde{g}\right)^2\right\}$$

The union's preferred combination of outcomes and expenditure gap is:

$$\Omega = \left\{-\beta_{\tilde{x}}, \frac{\beta_{\tilde{x}}}{\beta_{gu}}\right\}$$

Similarly for the government we obtain:

$$\Sigma = \left\{-\frac{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right)\alpha_{gf}}{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right)\left(1 + \alpha_{gf}\right) + \alpha_{\pi f}}\tilde{g}, \frac{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right) + \alpha_{\pi f}}{\alpha_{\pi m}\left(1 + \alpha_{\pi m}\right)\left(1 + \alpha_{gf}\right) + \alpha_{\pi f}}\tilde{g}\right\}$$

[16] The union can set the real distortions in the labor market, but it does not know the price level. Thus, more correctly, it should be said that the union sets the post-forecasting real wage distortion. Note also that given the static nature of the model, inflation equals the price level, i.e. $\pi = p$.

Appendix C – Stackelberg solution

The non-cooperative Stackelberg solution is derived by first solving the government problem, obtaining the following first order condition:

$$t = \frac{\alpha_{gf}\alpha_{\pi m}\left(1+\alpha_{\pi m}\right)\tilde{g} - \left(\alpha_{\pi f}+a_{\pi m}^{2}\right)\tilde{x}}{\left(\alpha_{\pi m}+\alpha_{\pi m}^{2}\right)\alpha_{gf}+\alpha_{\pi m}^{2}+a_{\pi f}}$$

and then solving the union problem, which yields:

$$\tilde{x} = \frac{\left[\alpha_{\pi m}\alpha_{gf}\left(1+\alpha_{\pi m}\right)+\alpha_{\pi m}^{2}+\alpha_{\pi f}\right]^{2}}{\alpha_{\pi m}^{2}\alpha_{gf}^{2}\left(1+\alpha_{\pi m}\right)^{2}+\beta_{gu}\left(\alpha_{\pi m}^{2}+\alpha_{\pi f}\right)^{2}}\beta_{\tilde{x}} - \tilde{g}$$

The corresponding equilibrium outcomes (point S in the figures) are:

$$\begin{aligned}
t &= g = \tilde{g} - \frac{\left(\alpha_{\pi f}+\alpha_{\pi m}^{2}\right)\left[\alpha_{\pi m}\alpha_{gf}\left(1+\alpha_{\pi m}\right)+\alpha_{\pi m}^{2}+\alpha_{\pi f}\right]}{\alpha_{\pi m}^{2}\alpha_{gf}^{2}\left(1+\alpha_{\pi m}\right)^{2}+\beta_{gu}\left(\alpha_{\pi m}^{2}+\alpha_{\pi f}\right)^{2}}\beta_{\tilde{x}} \\
\pi &= \frac{\left(1+\alpha_{\pi m}\right)\left[\alpha_{\pi m}\alpha_{gf}\left(1+\alpha_{\pi m}\right)+\alpha_{\pi m}^{2}+\alpha_{\pi f}\right]\alpha_{gf}}{\alpha_{\pi m}^{2}\alpha_{gf}^{2}\left(1+\alpha_{\pi m}\right)^{2}+\beta_{gu}\left(\alpha_{\pi m}^{2}+\alpha_{\pi f}\right)^{2}}\beta_{\tilde{x}} \\
x &= -\frac{\left(1+\alpha_{\pi m}\right)\left[\alpha_{\pi m}\alpha_{gf}\left(1+\alpha_{\pi m}\right)+\alpha_{\pi m}^{2}+\alpha_{\pi f}\right]\alpha_{\pi m}\alpha_{gf}}{\alpha_{\pi m}^{2}\alpha_{gf}^{2}\left(1+\alpha_{\pi m}\right)^{2}+\beta_{gu}\left(\alpha_{\pi m}^{2}+\alpha_{\pi f}\right)^{2}}\beta_{\tilde{x}}
\end{aligned}$$

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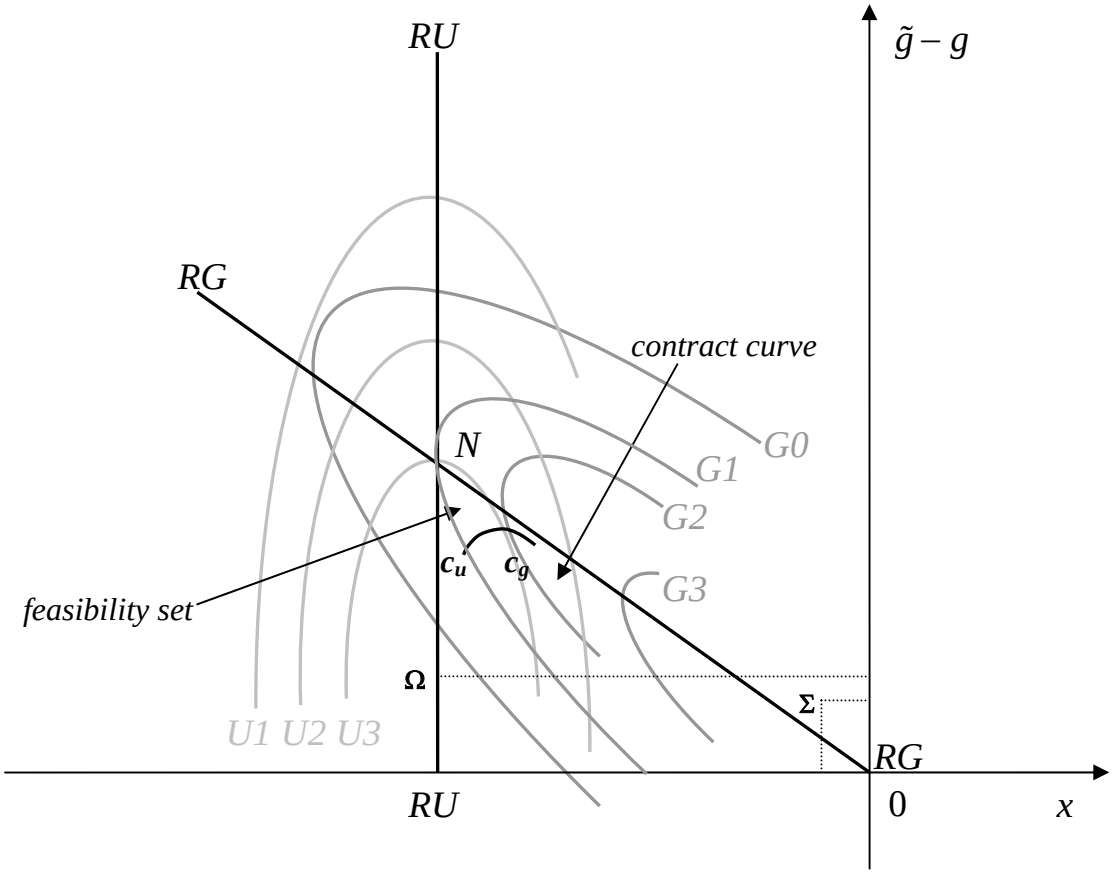
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contract curve
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Figure 1

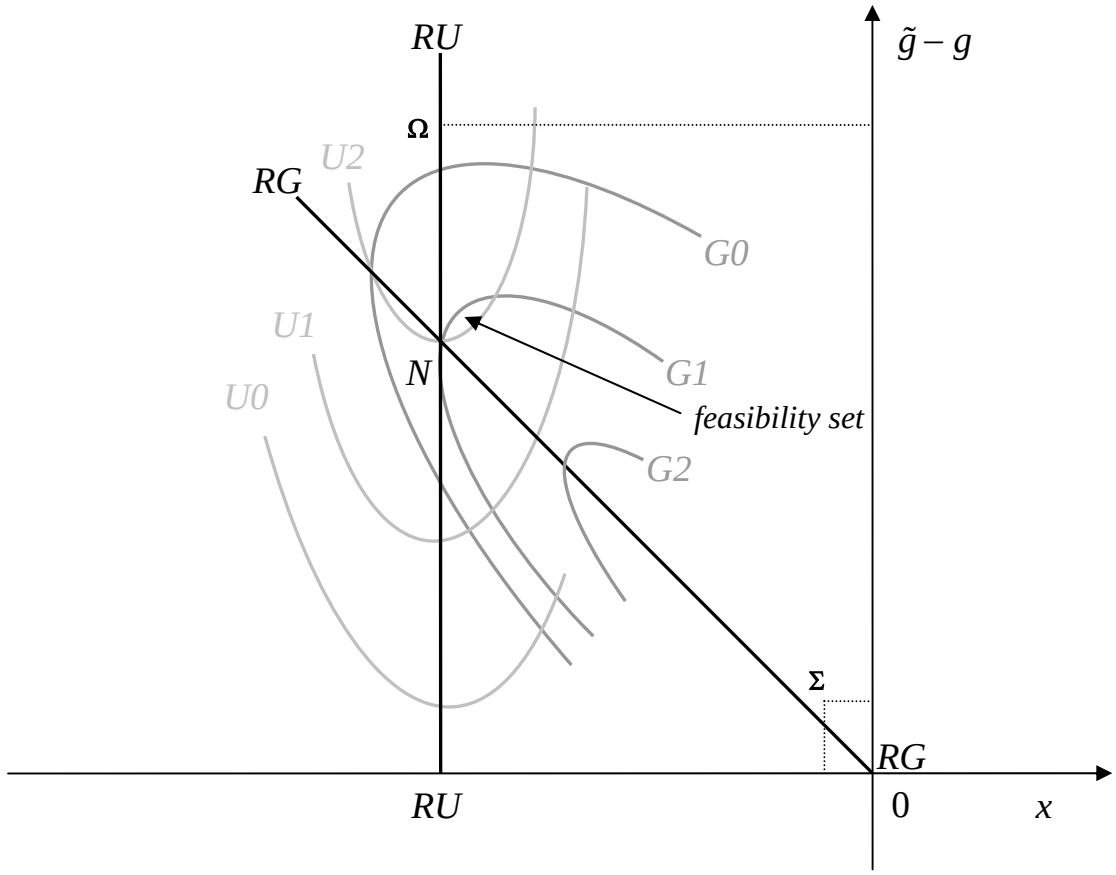

Figure 2

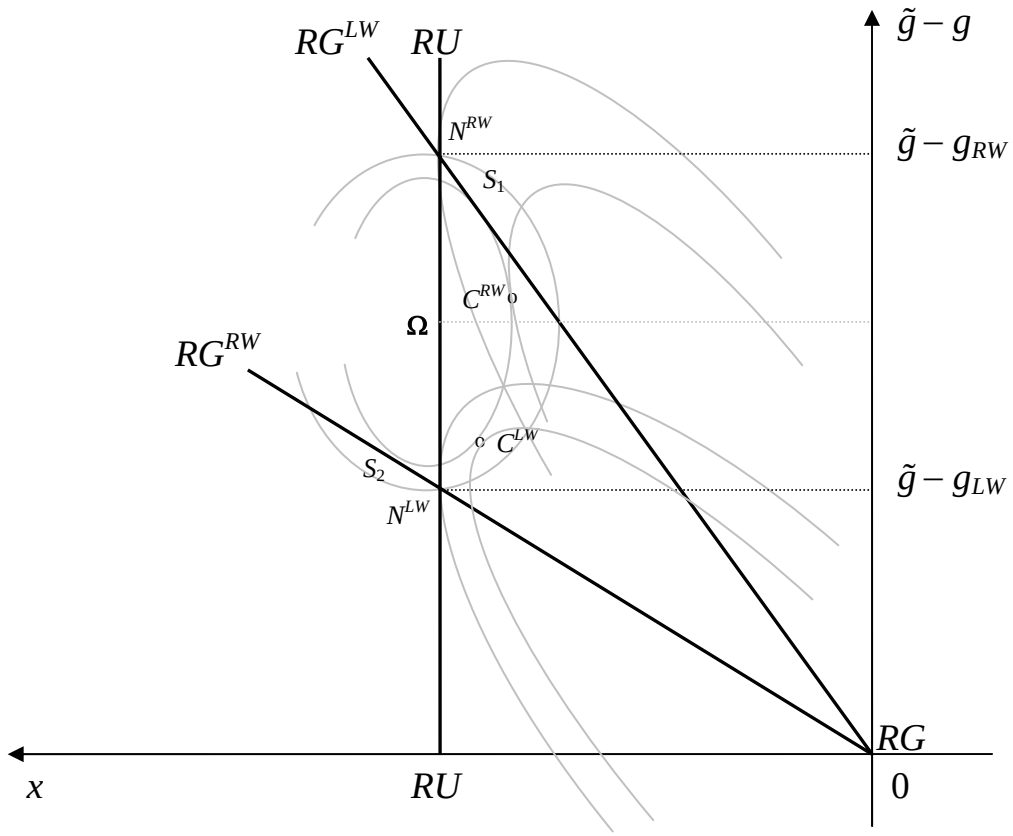
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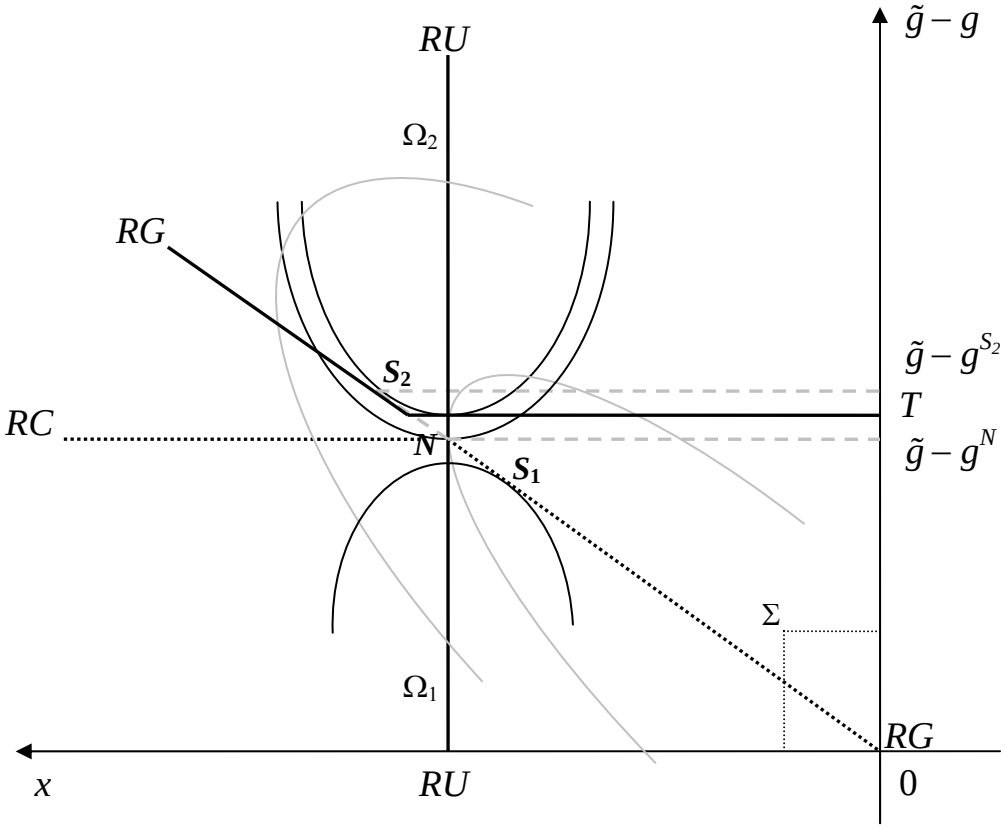
Figure 3


RU
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S_1
Σ
Ω_1
RG
x
RU
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Figure 4