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Fiscal and monetary interactions when wage-setters are large: is there a role for corporatist policies?

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Abstract This paper studies the macroeconomic consequences of alternative policy regimes in a closed economy where a central bank, a fiscal authority and a monopoly union interact via their effects on output and inflation. The analysis compares macroeconomic outcomes in a non-cooperative setting, where players may move sequentially or simultaneously, and in a regime of cooperation between the government and wage-setters. The cooperative regime captures a climate of accord among social parties that is finalised at common macroeconomic targets in the tradition of corporatism, as in the recent experience of "social pacts" in many European countries. The paper makes two main contributions. First, it shows that macroeconomic outcomes are suboptimal in the non-cooperative regime and may deliver extreme (undesirable) results even when all players share common ideal targets for output and inflation. All players would be better off with a less extreme value for output or inflation, yet they fail to reach a more advantageous allocation as long as there is an inherent conflict among their further objectives. Moreover, the result is robust to a change in the degree of central bank's conservatism. Second, I find that cooperation between the government and the monopoly union towards common ideal targets for inflation, output and taxes enhances social welfare even in the absence of explicit coordination with the central bank.

Keywords Policy games · Monetary and fiscal policy interactions · Wage bargaining · Trade unions · Social pact · Corporatism

JEL Classification E52 · E61 · E63 · J51

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1 Introduction

This paper studies the macroeconomic implications of alternative policy regimes in a closed economy where a central bank, a fiscal authority and a monopoly union interact via their effects on output and inflation. The analysis compares the macroeconomic performance in a non-cooperative setting, where players may move simultaneously or sequentially, and in a regime of cooperation between the government and wage-setters. The cooperative regime captures a climate of accord among social parties that is finalised at common macroeconomic targets as in the recent experience of "social pacts" in Europe.[1]

The paper draws on a key insight from recent developments in the literature on strategic wage-bargaining, showing that the policy setup, as represented, for instance, by the degree of central bank's conservatism, can have a permanent effect on both inflation and output. As well-known, the result is a consequence of large wage-setters anticipating the response of policy-makers to their actions and therefore behaving more or less aggressively depending on the type of central banker on duty. In most studies in this area, the policy game typically involves the central bank and trade-unions, with fiscal policy eventually being considered exogenous.[2] Yet, fiscal policy contributes to shape the strategic environment faced by the central bank and wage-setters, with non-negligible consequences for their behaviour. Actually, structural features of fiscal policy making, as the extent of automatic stabilizers or the degree of corporatism, appear to play a relevant role in explaining cross-country differences in macroeconomic performance as documented by, respectively, Canzoneri et al. (2002) and Summers et al. (1993). The way monetary and fiscal interactions display their effects in the economy, on the other side, depend on wage distortions that are to a certain degree endogenous to the policy context. This paper aims to fill the gap by investigating monetary and fiscal policy interactions in a framework with large wage-setters. I will address both positive and normative issues by comparing macroeconomic outcomes and welfare in a non-cooperative setting and in a corporatist regime where fiscal authorities cooperate with trade unions.

The paper rests on a general-equilibrium model characterised by monopoly distortions à la Blanchard and Kiyotaki (1987), where money is introduced through a cash-in advance constraint and taxes are distortionary. I consider a policy game where the central bank controls the money supply, the government sets the tax rate and the monopoly union bargains nominal wages on behalf of its members. All players care about output and inflation, yet attaching different weights and targets to these variables. As usual in models of trade unions' behaviour, the monopoly union is also interested in the real wage of its members. This assumption is crucial as the attempt on the part of the union to increase the real wage above the competitive level introduces an endogenous distortion which is at the origin of the inflationary bias in the economy. As in Dixit and Lambertini (2001) and Lambertini (2006), the government also desires to limit tax distortions.

[1] See Burda (1997) for a survey on corporatism.

[2] Acocella et al. (2007a, b) provide a notable exception.

I find that macroeconomic outcomes are sub-optimal in the non-cooperative regime independently on whether the players accord on the ideal targets for inflation and output. The result is a consequence of an inherent conflict among the objectives of the players arising from an insufficient number of instruments. In the struggle for realising his own goals, each player will be induced to act in an opportunistic way, thereby leading to extreme (undesirable) outcomes. As a way of example, consider the failure on the part of wage-setters to internalise the adverse macroeconomic effects of monopoly distortions in labour markets. As long as the monopoly union attempts to increase the real wage of its members above the competitive standard by negotiating an increase in the nominal wage, the central bank will have an incentive to counteract the macroeconomic consequences of the wage hike by means of a monetary expansion. For the same motives, the government will recur to a fiscal expansion, unless he realises that any attempt to stimulate the economy is bound to fail in equilibrium as it is the case when he has the first mover advantage. As a result of excessive policy activism, in turn, either an overheated or a stagflationary scenario may occur, depending on the relative importance of output and inflation for the central bank and the monopoly union. The macroeconomic outcome is in any case characterised by extreme values of output and inflation for all players.

I then consider a corporatist regime with same ideal targets for all players where the government and the monopoly union behave cooperatively among each-others while playing non-cooperatively towards the central bank. I show that corporatism improves welfare by leading to less extreme macroeconomic outcomes than in the non-cooperative regime. Moreover, as long as the government has full bargaining power, it can restore the first best equilibrium. In order to see why, consider that the monopoly union will have a greater incentive to internalise the adverse macroeconomic consequences of an aggressive wage behaviour when cooperating with the government. She will therefore reduce her wage claims and eventually give up the attempt to increase the utility of her members by demanding a rise in their nominal wage above the competitive level. As the output gap is progressively bridged, both the central bank and the government will be less active than in the non-cooperative regime, thereby reducing the inflationary bias in the economy. I stress that the corporatist policy is feasible, in the sense that it gives to all participants in the accord at least the same utility than in the non-cooperative regime, as long as the union is sufficiently interested in output relative to the his other targets and the government does not care too much about tax distortions.

The findings in the paper may be of help in the current debate on macroeconomic policy design. On the theoretical side, they support the view that endogenous wage distortions should be taken into account seriously when analysing fiscal and monetary interactions. In the model provided in this paper, wage behaviour is at the origin of sub-optimal macroeconomic outcomes both in cooperative and non-cooperative regimes. As regards policy implications, I first argue that monetary conservatism per se may not be of much help in reducing the inflationary bias in the economy as long as there is an inherent conflict between the objectives of the central bank, wage-setters and the government. Moreover, it may even turn counter-productive. Second, I make a case in favour of a corporatist policy linking wage bargaining to common macroeconomic targets in terms of output, inflation and taxes.

2 The economy

I consider a closed economy characterised by monopoly distortions in goods and labour markets in the tradition of Blanchard and Kiyotaki (1987). The "Appendix" provides a full description of the underlying model. In what follows, I will focus on the log-linear expressions for inflation and output (derived in the "Appendix") as given by:

$$\pi_t = (1-\alpha)m_t + \alpha(\tau_t + w_t) \tag{1}$$

$$y_t = \alpha(m_t - \tau_t - w_t) \tag{2}$$

where $\pi_t \equiv p_t - p_{t-1}$ is the inflation rate defined as the percent change in the price level between two periods, y is real GDP, w is the nominal aggregate wage, m is a monetary aggregate and $\tau \equiv -\log(1-t)$ measures taxes (or subsidies) on labour incomes at rate t.[3] All variables in the above equations are in (natural) logarithms and represent deviations from the perfectly competitive equilibrium, so that y_t, for instance, can be interpreted as the output gap in period t. The policy instruments are defined so that an increase in m means a monetary expansion and an increase in the absolute value of τ is associated with a larger dimension of the public sector.[4] Note that taxes on labour may comprise both a social security tax paid by the employer and an income tax, paid by workers, as in Alesina and Perotti (1997). As it will be apparent soon, the presence of tax distortions raises a potential trade-off in fiscal policy making, implying that the advantage of moving the fiscal lever always comes with a deadweight cost. The implications of tax distortions for policy games have been stressed, among others, by Cukierman and Dalmazzo (2007) in a model with taxes on labour and non-atomistic wage-setters and Beetsma and Bovenberg (1998) and Dixit and Lambertini (2001) in models of fiscal and monetary interactions with income taxes.

Equation (1) links the inflation rate in each period to the policy variables and wages. Note that higher taxes on labour are associated with higher inflation in my setup with non-competitive markets. A rise in the cost of labour to the firm, due to an increase in taxes or in nominal wages, leads to an increase in prices as a result of monopolistic competitive firms setting prices at a constant mark-up on nominal marginal costs.

Equation (2) similarly expresses in reduced-form the effects of policy variables and wages on output. A monetary expansion is associated with a boost in aggregate demand that will be accommodated by an increase in output as long as prices are fixed. Higher taxes and a rise in nominal wages, on the other side, will depress output by increasing marginal costs.

There are three actors in the economy: the central bank, the fiscal authority and wage-setters as represented by a monopoly trade union that bargains nominal wages

[3] Note that τ is positive for $t \in (0, 1)$ and negative when the government subsidizes labour incomes, i.e. when $t < 0$.

[4] With a balanced public budget in every period, higher taxes on labour are compensated by higher expenditures.

on behalf of its members. The government cares about deviations of output, inflation and taxes from some desired levels, as given by the following loss function:

$$L^{G} = \frac{1}{2}\left[\eta\left(y_t - y^{G}\right)^2 + \left(\pi_t - \pi^{G}\right)^2 + \delta\left(\tau_t - \tau^{G}\right)^2\right] \tag{3}$$

where y^{G}, π^{G} and τ^{G} are the targets for, respectively, output, inflation and taxes pursued by the government and the parameters η and δ capture their relative importance. A quadratic loss as (3) is typical in the literature on policy games, at least as far as the first two addends are concerned. The third addend captures the costs associated with tax distortions, in the same vein as in Dixit and Lambertini (2001) where these costs refer to the production of a fiscal subsidy. It is noteworthy to clarify at this point the nature of the trade-off facing the government: a rise in taxes may be of help in reducing an excessively high output, according to Eq. 1, yet at the expense of higher inflation (see Eq. 2). By the same token, in cyclical downturns, a fiscal expansion engineered through a tax cut or a subsidy on labour incomes helps bridging the output gap while deflating prices. As it will become apparent soon, the trade-off in fiscal policy may give rise to excessive activism on the part of the government.

As usual in the literature stressing the time-inconsistency problem of monetary policy, the central bank is assumed to care about output and inflation:

$$L^{M} = \frac{1}{2}\left[\lambda\left(y_t - y^{M}\right)^2 + \left(\pi_t - \pi^{M}\right)^2\right] \tag{4}$$

where y^{M} and π^{M} are, respectively, the output and inflation targets of the monetary authority and λ is a measure of the relative importance of the two policy goals. It is worth noticing that both the targets of the central bank and their weights may differ from those of the other players. A conservative central bank in the terminology introduced by Rogoff (1985) is captured by a value of λ lower than η.

The representative trade-union is assumed to be interested in stabilising output and inflation around some desired levels while also benefiting from an increase in the real wage of its members:

$$L^{U} = \frac{1}{2}\left[\beta\left(y_t - y^{U}\right)^2 + \left(\pi_t - \pi^{U}\right)^2 - 2\gamma(w_t - p_t)\right] \tag{5}$$

A linear-quadratic loss function as in the above equation is standard in the literature on trade-unions' behaviour where unions typically trade-off the advantages of higher employment (or output) with the need to increase labour incomes in real terms.[5] More recent studies stress the possibility that unions are averse towards inflation.[6]

[5] See Booth (2002) for a textbook treatment of this literature. A classic survey is Oswald (1982).

[6] See Calmfors (2001) and Cukierman (2004) for extensive surveys of this literature. The assumption that unions are interested in inflation does not affect my qualitative results. The proof is available upon request.

3 Non-cooperative regime

I will consider both a simultaneous and a sequential game. In the first case, all actors move independently and simultaneously, playing Nash among each-others. The simultaneous game captures a situation where all players have the same strategic weight. In the sequential game, instead, one of the players is the leader. For reasons that will become apparent soon, I focus on the case where the government acts as a Stackelberg leader, setting the tax rate in the first stage of the game. Then in the second stage, the central bank and the monopoly union independently and simultaneously set, respectively, the money supply and nominal wages. The possibility that the government has the first mover advantage is meant to capture, within a static framework, the fact that his decisions are stickier than those of the other players. Fiscal decisions, in fact, typically involve a lengthy legislative process. The simultaneous and the sequential games are solved by backward induction.

3.1 The non-cooperative equilibrium

The best strategy for the monetary authority is obtained by differentiating Eq. 4 with respect to m under the economy's constraints (1) and (2) and taking the behaviour of the other players as given, yielding:

$$\lambda\alpha\left(y_t - y^{\mathrm{M}}\right) + (1-\alpha)\left(\pi_t - \pi^{\mathrm{M}}\right) = 0 \quad \text{or} \quad y_t = y^{\mathrm{M}} + \frac{(1-\alpha)}{\lambda\alpha}\left(\pi^{\mathrm{M}} - \pi_t\right). \tag{6}$$

This defines the monetary reaction function, MRF, in the space (y, π). MRF is negatively sloped.

The first order condition for wage-setting, resulting from the minimisation of Eq. 5 with respect to w subject to (1) and (2), is as follows:

$$\begin{aligned} -\beta\alpha\left(y_t - y^{\mathrm{U}}\right) + \alpha\left(\pi_t - \pi^{\mathrm{U}}\right) - \gamma(1-\alpha) = 0 \quad \text{or} \\ y_t = y^{\mathrm{U}} + \frac{1}{\beta}\left[\left(\pi_t - \pi^{\mathrm{U}}\right) - \frac{\gamma(1-\alpha)}{\alpha}\right] \end{aligned} \tag{7}$$

The reaction function of trade-unions, URF, is positively sloped. Note that the URF does not pass through the union' bliss point (π^{U}, y^{U}) unless unions are not concerned about real wages, namely when $\gamma = 0$.

Finally, the strategy of the fiscal authority depends on whether she has the first mover advantage. In the simultaneous game, where the fiscal authority plays Nash towards the other players, the optimal policy is:

$$\tau_t = \tau^{\mathrm{G}} + \frac{\alpha}{\delta}\left(\eta\left(y_t - y^{\mathrm{G}}\right) - \left(\pi_t - \pi^{\mathrm{G}}\right)\right) \tag{8a}$$

The government will set the tax rate by striking a balance between output and inflation: taxes are raised whenever output is above the ideal target, yet not so much as to fuel inflation.

In the sequential game, the government takes into account the reaction functions of the other players, Eqs. 6 and 7, in addition to the economy's constraints when deciding his best strategy, yielding:

$$\tau_t = \tau^{G} \tag{8b}$$

Note that the advantage of being first-mover makes the government realise that he cannot permanently improve the trade-off between inflation and output in the economy. Any attempt to, say, boost output by means of a fiscal expansion would be offset by a monetary contraction or higher wage claims on the part of unions, resulting in higher inflation. The best thing for the government is therefore to keep taxes as close as possible to the desired level, as in Eq. 8b.

In equilibrium, output and inflation are given by:

$$\begin{aligned} y_t &= \frac{1}{\lambda\alpha + \beta(1-\alpha)}\left[\lambda\alpha y^{M} + \beta(1-\alpha)y^{U} + (1-\alpha)\left(\pi^{M} - \pi^{U}\right) - \frac{\gamma(1-\alpha)^2}{\alpha\beta}\right] \\ \pi_t &= \frac{\lambda\alpha\beta}{\lambda\alpha + \beta(1-\alpha)}\left[y^{M} - y^{U} + \frac{\pi^{U}}{\beta} + \frac{\gamma(1-\alpha)}{\alpha\beta} + \frac{\pi^{M}(1-\alpha)}{\alpha\lambda}\right] \end{aligned} \tag{9}$$

I stress that this outcome does not depend on whether the fiscal authority has the first mover advantage. Output and inflation are in fact determined as a result of monetary and wage interactions, i.e. from Eqs. 6 and 7. Yet, the fiscal strategy is crucial for the determination of overall tax distortions in the economy. From Eq. 8a and 8b, it appears that tax distortions will be higher in the simultaneous game where the government does not anticipate the behaviour of the other players and therefore has a greater incentive to move the fiscal instrument in the attempt to influence output and inflation. Moreover, tax distortions will affect labour incomes in the economy. Using labour demand, Eq. 25 in the "Appendix", it is easy to derive the real wage wedge defined as the difference between the (log) real wage with monopolistic competition and the (log) real wage under perfect competition as follows:

$$w_t - p_t = \frac{\alpha - 1}{\alpha} y_t - \tau_t \tag{10}$$

The real wage wedge is negatively associated with the output gap, implying that real wages will be higher than the competitive standard as long as output is below the competitive level, and positively associated with subsidies on labour incomes. A negative tax rate, i.e. a negative τ, will in fact increase labour incomes both directly and through its effect on prices. The subsidy reduces the labour cost to the firm, leading to lower prices and higher labour incomes in real terms. The opposite is true when the government taxes labour incomes, i.e. when τ is positive.

The non-cooperative outcome is clearly sub-optimal from the standpoint of society as represented by the utility of all agents in the economy (Eq. 26 in the "Appendix"). The first best for society coincides with the perfectly competitive equilibrium, namely when deviations of output, inflation and taxes from the competitive standard are nil (as discussed in the "Appendix"). Moreover, it may lead to extreme (undesirable) results for all players. Depending on parameter values, either an overheated or a stagflationary scenario may occur. A combination of output higher than the competitive standard and positive inflation (the overheated equilibrium) materialises whenever $y^{M} < y^{U}$ and $\pi^{M} < \pi^{U}$, and where unions are

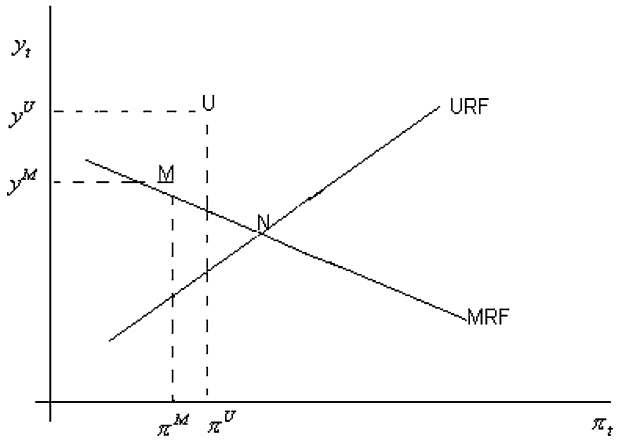

Fig. 1 Output and inflation in the Nash equilibrium

relatively more concerned about output than inflation, i.e. when $\beta > \pi^{U}/y^{U}$ $(1/\alpha(1-\gamma(1-\alpha)))$, as depicted in Fig. 1.

The non-cooperative equilibrium, point N, lies to the south–east of the bliss points of both the central bank and trade unions, points M and U, respectively, implying that inflation is higher than their ideal level while output is below the target. The combination of high inflation and low output is clearly bad for all players. Moreover, excessive tax distortions contribute to deteriorate the payoffs of the fiscal authority in the simultaneous game (see Eq. 8a). I stress that the non-cooperative equilibrium might also materialise in the second quadrant of the space (y, π), with output below the competitive standard and positive inflation. The outcome combining high inflation with an even lower level of output is clearly more disadvantageous for all players.

3.2 Symbiosis in macroeconomic policies?

Now, consider the idyllic situation where all players desire the levels of output, inflation and taxes that are socially optimal, namely when $\pi^{M} = \pi^{G} = \pi^{U} = y^{M} = y^{U} = y^{G} = 0$. Note that accord on the ideal targets does not imply that the inherent conflict among the objectives of the players will disappear. In my setup with non-atomistic wage-setters, the conflict arises from the desire on the part of the monopoly union to raise labour incomes above the competitive standard.

With zero targets, Eq. 9 simply blur to the following:

$$\begin{aligned} y_t &= \frac{\gamma(1-\alpha)(\alpha-1)}{\alpha(\lambda\alpha+\beta(1-\alpha))} < 0 \\ \pi_t &= \frac{\lambda\gamma(1-\alpha)}{(\lambda\alpha+\beta(1-\alpha))} > 0 \end{aligned} \tag{11}$$

Moreover, tax distortions will disappear in the sequential game. In the simultaneous game, instead, the government will subsidize labour incomes.[7] The incentive to sustain labour incomes by means of a fiscal expansion derives from the attempt on the part of the government to boost output (which is below the competitive standard) and reduce inflation. Clearly, such an attempt is deemed to fail in equilibrium, where the fiscal stimulus is nullified by the behaviour of the other players. The finding of excessive activism on the part of the fiscal authority is consistent with similar results in the literature (see, among others, Dixit and Lambertini (2003b) and Beetsma and Bovenberg (1998)).

Despite accord on the ideal targets, output and inflation are still sub-optimal. As argued before, this is due to the incentive on the part of wage-setters to keep wages above the competitive level.[8] The contrast with the results in Dixit and Lambertini (2003a), showing that the first best equilibrium can be replicated in a non-cooperative setting whenever there is accord among the players on the value of the ideal targets, is therefore only apparent. In their setup with fiscal and monetary interactions, there is no conflict among the objectives of the players as both policy-makers are interested in output and inflation and each of them controls one policy instrument that has effects on the two variables. The number of instruments therefore coincides with the number of targets when policy-makers accord on the ideal levels of output and inflation. Consequently, the common targets can be reached without any need to cooperate or to commit to some pre-determined rule, even if policy-makers assign a different weight to these goals.

In my setup with large wage-setters, on the contrary, monopoly distortions in labour markets imply a potential conflict among the objectives of the players. Despite the monopoly union internalises to a certain degree the adverse effect that a rise in nominal wages might have on output and inflation, she desires to keep wages above the competitive level, overlooking the implications of her moves for fiscal and monetary policy. The central bank, on the other side, takes the wage behaviour as given. Therefore, a liberal central bank will simply accommodate the wage pressure, thereby contributing to fuel inflation. An ultra-liberal central bank, namely a monetary authority that does not care about inflation at all so that $\lambda \to \infty$, will eventually manage to eliminate the output gap completely while accelerating inflation permanently (see Eq. 11). By the same token, a combination of low inflation and a high output gap would prevail whenever the central bank is conservative. In the limit case where the central bank is ultra-conservative, i.e. when $\lambda \to 0$, inflation goes to zero and output will permanently be below the competitive level. Finally, the fiscal authority will try, unsuccessfully, to sustain output and control inflation by means of a fiscal expansion whenever she takes wage behaviour as given, namely when she has no first mover advantage.

[7] Evaluating Eq. 8a with zero targets gives $\tau_t = \frac{\gamma(\alpha-1)(\eta(1-\alpha)+\lambda\alpha)}{\delta(\lambda\alpha+\beta(1-\alpha))}$.

[8] Such an incentive disappears whenever wage-setters are not interested in real wages, i.e. when $\gamma = 0$.

4 Macroeconomic outcomes and corporatism

The possibility of sub-optimal macroeconomic outcomes in the non-cooperative regime raises the question of whether the players could be induced to eliminate the "endogenous" distortions in the economy, replicating the equilibrium that would prevail with perfectly competitive markets. In what follows, I will focus on the most favourable case where all players share the same ideal targets for inflation and output. I consider a regime where the trade union and the government behave cooperatively between each-others, while playing Nash towards the central bank.[9] Cooperation between unions and the government is typical of so-called corporatist regimes where there is an explicit or implicit accord between the government and social parties. A notable example of corporatism is provided by the "social pact", where the climate of social accord is aimed at realising specific macroeconomic targets. These policies have been extensively used in many European countries as part of the disinflation strategy in the run-up to the EMU.[10]

In the absence of a binding agreement, i.e. within a non-cooperative game, the climate of accord among social parties can be captured by means of a "coordinated solution" where the fiscal authorities and the monopoly union maximise a linear combination of their respective loss functions:

$$\mu L^{\mathrm{G}} + (1-\mu)L^{\mathrm{U}} \tag{12}$$

where $\mu \in (0, 1)$ is an indicator of the governments' bargaining power.[11] The first order condition for the monopoly union modifies as follows:

$$\mu[-\eta\alpha y + \alpha\pi] + (1-\mu)[-\beta\alpha y + \alpha\pi - \gamma(1-\alpha)] = 0 \tag{13}$$

where nominal wages are now set so as to strike a balance between the government's and the workers' objectives (respectively, the first and the second addend on the LHS of Eq. 13).

The optimal strategy of the government in the simultaneous and the sequential game is given by, respectively:

$$\mu[\delta\tau - \alpha\eta y_t + \alpha\pi_t] + (1-\mu)[\gamma - \alpha\beta y_t + \alpha\pi_t] = 0 \tag{14a}$$

$$\mu[\delta\tau] + (1-\mu)[\gamma] = 0 \tag{14b}$$

Comparing the equations above with the corresponding ones in the non-cooperative regime, (8a) and (8b), it appears that the government has a greater incentive to move

[9] The cooperative regime is considered as given, overlooking the factors that are behind the decision to cooperate in the first place. The incentives on the part of unions to cooperate with social parties may be affected by institutional and economic factors, as shown in Colombo et al. (2008). See also Holden (2005) for an account of the impact of monetary policy regimes on wage coordination and Boeri and Burda (2008) for a model of collective versus individualised wage-setting.

[10] Significant agreements between social parties over macroeconomic goals have been recorded in the 1990s in The Netherlands, Ireland, Finland, Norway, Italy, Portugal and Spain, as documented, among others by Fejertag and Pochet (1997, 2000). See Cavallari (2008) for a critical view on the Italian income agreements in the current monetary regime.

[11] For a discussion on Nash bargaining as alternative to the coordinated solution of a non-cooperative game see, among others, Acocella and Di Bartolomeo (2007).

the fiscal instrument under corporatism. The reason is due to the fact that taxes and nominal wages are strategic substitutes: an increase in taxes has the same effect in the model as a rise in nominal wages. Therefore, the government will consider the impact of taxes on labour incomes when cooperating with the monopoly union. Note that this is true also in the sequential game, (14b), where the government subsidizes labour incomes despite realizing that he cannot permanently affect the trade-off between output and inflation. The subsidy, in fact, is a means for keeping wages above the competitive level (see Eq. 10).

Equilibrium output and inflation, both in the simultaneous and the sequential game, are as follows:

$$\begin{aligned} y &= \frac{(1-\mu)\gamma(1-\alpha)(\alpha-1)}{(\lambda\alpha+(1-\alpha)((1-\mu)\beta+\mu\eta))\alpha} \\ \pi &= \frac{(1-\mu)\gamma\lambda(1-\alpha)}{\lambda\alpha+(1-\alpha)((1-\mu)\beta+\mu\eta)} \end{aligned} \tag{15}$$

while tax distortions are given by, respectively:

$$\begin{aligned} \tau &= \frac{(\mu-1)\gamma\alpha}{\mu\delta} \\ \tau &= \frac{(\mu-1)\gamma}{\mu\delta} \end{aligned} \tag{16}$$

Note that differently than in the non-cooperative game, tax distortions are now higher when the government has the first mover advantage. Whenever the government internalizes the real wage objective of the monopoly union, in fact, she will realize that higher subsidies are needed for a given level of output and inflation. In the simultaneous game, where the fiscal instrument affects real wages both directly and via its effects on output and inflation, the amount of the subsidy will therefore be lower.

In general, the corporatist regime may deliver a first or a second best. It is therefore of interest to investigate in detail under what conditions the various outcomes materialise.[12]

The first best is replicated when the government has full bargaining power, i.e. with $\mu = 1$, so that the perfectly competitive equilibrium is restored. In this case, cooperating with the government effectively amounts to giving up the real wage objective in favour of output and inflation. As it will become apparent soon, this turns out to be in the interest of "certain types" of trade unions. Note that the result holds despite the absence of an explicit form of coordination with the central bank. As long as there is full cooperation with the government, in fact, the monopoly union is induced to give up any attempt to increase wages above the competitive level, leading the economy to the natural equilibrium. Once the output gap is

[12] The third best would materialize with $\mu = 0$, when output and inflation distortions are the same as in the non-cooperative regime yet with higher tax distortions. It is easy to verify that the participation constraint of the monopoly union is not verified in this case, implying that the accord would not be feasible.

completely bridged, in turn, monetary policy will have no reason for creating inflation and the inflationary bias in the economy will therefore vanish.

I stress that the first best outcome is feasible, in the sense that the participation constraint of both the government and the monopoly union is satisfied, under certain parameter conditions. It is immediate to verify that the loss of the government is nil in the first best and therefore below the one in the non-cooperative regime. The government always finds it profitable to cooperate with the union. The monopoly union, on the contrary, will find it convenient to cooperate with the government only as long as the advantage in terms of output and inflation in the corporatist regime does not fall short of the loss in terms of real wages. Using Eqs. 10 and 11 and evaluating Eq. 15 with $\mu = 1$, I can write the participation constraint for the union as follows:

$$\begin{aligned} & L^{\mathrm{U}}_{|\mathrm{nc}} - L^{\mathrm{U}}_{|\mathrm{coop}} \geq 0 \quad \text{iff} \\ & \beta y^2_{\mathrm{nc}} + \frac{\alpha^2\lambda^2}{(\alpha-1)^2} y^2_{\mathrm{nc}} + \frac{2\gamma(1-\alpha)}{\alpha} y_{\mathrm{nc}} + 2\gamma\tau_{\mathrm{nc}} \geq 0 \end{aligned} \tag{17}$$

where the subscripts nc and coop stand for, respectively, non-cooperative and cooperative regime. Using Eq. 11 and the equilibrium value of τ in the simultaneous and the sequential non-cooperative equilibrium, it is easy to verify that the equation above is satisfied, meaning that cooperation is feasible, when the union attaches a sufficiently high weight to the output target, i.e. when:

$$\begin{aligned} \beta &\geq \frac{\left[2(1-\alpha) - \alpha^2\lambda^2\right]}{(\alpha-1)^2} \\ \beta &\geq \frac{\left[2(\alpha-1)^2 + \alpha^2(\eta(1-\alpha) + \alpha\lambda) - \alpha^2\lambda^2\right]}{(\alpha-1)^2} \end{aligned} \tag{18}$$

in, respectively, the sequential and the simultaneous game. Interpreting the feasibility condition, it says that "liberal" unions, in the sense of unions that are particularly interested in macroeconomic output, will find it profitable to cooperate with the government. The more the union cares about output, in fact, the lower the output gap in the non-cooperative equilibrium (Eq. 11) and the lower the corresponding real wage wedge (Eq. 10). Consequently, the loss in terms of real wages in the corporatist regime is more than compensated by the gain in terms of output and inflation. I further stress that the feasibility condition in the simultaneous game is more stringent than the one in the sequential game.

With $\mu > 0$, the corporatist outcome is a second best from the standpoint of society since output distortions are always below those in the non-cooperative regime.[13] I stress that the cooperative outcome, although advantageous for society, may be unfeasible not only for the monopoly union, as it is the case in the first best, but for the government as well. The participation constraint of the government is violated whenever the lower loss in terms of output and inflation that materializes in the corporatist regime (the first addend in the expression below) is more than compensated by eventually higher tax distortions (the second addend), i.e.:

[13] Note that agents' utility (26) is a decreasing function of output distortions.

$$L^{G}_{|nc} - L^{G}_{|coop} \geq 0 \quad \text{iff}$$
$$\left(\beta + \frac{\alpha^2\lambda^2}{(\alpha-1)^2}\right)\left(y^2_{nc} - y^2_{coop}\right) + \delta\left(\tau^2_{nc} - \tau^2_{coop}\right) \geq 0 \tag{19}$$

Substituting y_{nc} and y_{coop} from, respectively, Eqs. 11 and 15, and doing the same with τ_{nc} and τ_{coop}, the condition above reduces to:

$$\delta \leq \frac{\gamma^2(1-\mu)^2\left[\eta\alpha^2(\lambda\alpha+\beta(1-\alpha))^2+\mu^3(2-\mu)\alpha^2\lambda^2\gamma^2(1-\alpha)^2\right]}{\alpha^2(\lambda\alpha+\beta(1-\alpha))^2} \equiv \delta^*$$
$$\delta \leq \delta^* \frac{\gamma^2(1-\mu)^2}{\alpha^2\gamma^2(1-\mu)^2-\gamma^2\mu^2(1-\alpha)^2(\alpha-1)^2} \tag{20}$$

in, respectively, the sequential and the simultaneous game. Clearly, since cooperation with the monopoly union may deteriorate the payoffs of the government solely along the tax dimension, all what is required for the feasibility of the accord is that tax distortions do not matter too much to the government. Note that the condition is more stringent in the sequential game as a result of the higher tax distortions that materialize in this case.

As regards the participation constraint of the monopoly union, a condition analogous to Eq. 18 requires that the gain associated with lower macroeconomic distortions in the corporatist regime (the first addend in the expression below) is higher that the loss due to lower wages (the second and third addends):

$$L^{U}_{|nc} - L^{U}_{|coop} \geq 0 \quad \text{iff}$$
$$\left(\beta + \frac{\alpha^2\lambda^2}{(\alpha-1)^2}\right)\left(y^2_{nc} - y^2_{coop}\right) + \frac{2\gamma(1-\alpha)}{\alpha}\left(y_{nc} - y_{coop}\right) + 2\gamma\left(\tau_{coop} - \tau_{nc}\right) \geq 0 \tag{21}$$

Once again, the condition is satisfied whenever β is sufficiently high and for exactly the same motives discussed above (corporatism improves union's welfare along the output and inflation dimension while reducing wages in real terms).

5 Concluding remarks

This paper has analysed strategic interactions among the central bank, the government and a monopoly trade union within a standard model of output and inflation with the aim of comparing macroeconomic outcomes and welfare under alternative policy regimes. I have considered a non-cooperative setting, in which the players may move simultaneously or sequentially, and a regime of cooperation between the government and the monopoly union. The cooperative setting is intended to capture a climate of accord among social parties in the tradition of corporatism.

I find that macroeconomic outcomes are suboptimal in non-cooperative regimes as long as there is an inherent conflict among the objectives of the players and may

deliver extreme (undesirable) results. In my setup, the conflict arises from monopoly distortions in the labour market. The monopoly union, in fact, will always have an incentive to keep the real wage of her members well above the competitive standard when behaving non-cooperatively. I stress that this is true despite the monopoly union internalises to a certain degree the adverse macroeconomic consequences of an excessive wage pressure. The central bank and the government, on the other side, will be excessively active in the vain attempt to sustain output and control inflation, thereby contributing to increase distortions in the economy.

In the corporatist regime, where the government and the monopoly union cooperate towards common ideal targets for inflation and output, macroeconomic outcomes are in general less extreme than in the non-cooperative regime and society's welfare improves. Moreover, I show that the first best equilibrium can be replicated when the government has full bargaining power so that the conflict among the objectives of the players actually disappears. The monopoly union, by fully internalising the adverse macroeconomic consequences of an aggressive wage behaviour, will set nominal wages at the competitive level, leading output to the competitive standard as well. Once the output gap is fully bridged, in turn, neither the central bank nor the government will have an incentive to stimulate the economy by means of (excessively) expansionary policies. Consequently, the inflationary bias and tax distortions in the economy will both vanish.

I stress that the cooperative regime is effectively feasible in the sense that it provides to all participants in the accord at least the same utility than in the non-cooperative regime under certain parameter conditions. With full bargaining power on the part of the government, for instance, the monopoly union will participate in the accord if and only if she attaches a high weight to output relative to her other objectives. In this case, in fact, the loss in terms of foregone wages that materialises in the cooperative regime is more than compensated by higher output.

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Appendix

The model

The economy is populated by a continuum of agents of unit mass, $j \in (0, 1)$, and a continuum of monopolistically competitive firms defined on the unit interval $i \in (0, 1)$. Each agent consumes a basket of goods that comprises all varieties produced in the economy and supplies its own type of labour services. Any pair of varieties of goods and labour services has a constant elasticity of substitution.

As in Lippi (2003) output, Y, is produced using differentiated labour inputs according to a constant return to scale technology:

$$Y_i = \left[\int_0^1 L_{ij}^{\frac{\varphi-1}{\varphi}} \mathrm{d}j\right]^{\frac{\alpha\varphi}{\varphi-1}} \tag{22}$$

where L_j is labour supplied by worker j, $\varphi > 1$ measures the elasticity of substitution among labour types and $\alpha \in (0, 1)$ is a return to scale parameter. Let W_j represent the nominal wage of worker j. Then, the price index for labour inputs, defined as the minimal nominal cost of producing a unit of output, is given as follows:

$$W = \left[\int_0^1 W_j^{(1-\varphi)} \mathrm{d}j\right]^{\frac{1}{1-\varphi}} \tag{23}$$

Cost minimisation implies that the demand for each type of labour is decreasing in the relative wage, as indicated in the expression below:

$$L_{ij} = \left(\frac{W_j}{W}\right)^{-\varphi} Y_i^{\frac{1}{\alpha}} \tag{24}$$

In a symmetric equilibrium with $W_j = W$, it is easy to derive aggregate employment as follows:

$$L = \left(\frac{W}{\alpha P}\right)^{-\frac{1}{1-\alpha}} \tag{25}$$

Note that the expression above coincides with equilibrium employment under wage bargaining since agents are willing to provide any amount of labour that is demanded in the economy at the wage rate negotiated by the monopoly union.

Agents derive utility from consumption, C, and dislike labour effort. In order to keep algebraic complexity at a bare minimum, utility is assumed to be additively separable in the two arguments:

$$U_j = \ln C_j - \frac{\kappa}{2} L_j^2 \tag{26}$$

with consumption given by the Dixit–Stiglitz aggregator:

$$C = \left[\int_0^1 (C_i)^{\frac{\theta-1}{\theta}} \mathrm{d}i\right]^{\frac{\theta}{\theta-1}} \tag{27}$$

where $\theta > 1$ captures the elasticity of substitution among varieties. It is easy to show that firms in the goods market face the following demand:

$$Y_i^d = \left(\frac{P_i}{P}\right)^{-\theta} C \tag{28}$$

where P_i is the price of variety i and P is the consumer-price index defined as follows:

$$P = \left[\int_0^1 (P_i)^{1-\theta} \mathrm{d}i \right]^{\frac{1}{1-\theta}} \tag{29}$$

Each firm will set the price for its own variety so as to maximize profits given market demand (28), yielding:

$$\frac{P_i}{P} = \left(\frac{\theta}{\alpha(\theta - 1)} \right)^{\frac{\alpha}{\Delta}} \left(\frac{W}{P(1-t)} \right)^{\frac{\alpha}{\Delta}} (C)^{\frac{1-\alpha}{\Delta}} \tag{30}$$

with $\Delta \equiv \alpha + \theta(1 - \alpha)$.

I assume that money is the sole financial asset and must be held at the beginning of each period in order to provide cash for nominal expenses:

$$M_j \geq PC_j \tag{31}$$

Money is supplied by the central bank and distributed across agents as a rainfall:

$$\overline{M} = \int_0^1 M_j \mathrm{d}j \tag{32}$$

where $\overline{M}$ is the initial endowment.

The budget constraint for agent j is as follows:

$$PC_j = WL_j + D_j \tag{33}$$

where D_j are nominal profits.

The government raises taxes on labour and utilises the proceeds to finance expenditures. As in Alesina and Perotti (1997), taxes on labour comprise a social security tax paid by the employer, at rate s, and an income tax, paid by workers at rate v. Denoting by GW the gross wage, a firm bears a per-worker cost of labour equal to GW$(1 + s)$ while the worker receives a net wage W = GW$(I - v)$. The cost of labour to the firm can therefore be written as $W(1 - t)$ where $(1 - t) \equiv (1 - v)/(1 + s)$ is the ratio between the net wage and the cost of labour. The government runs a balanced budget in each period:

$$PG = \frac{tW}{1-t} \tag{34}$$

where G is public expenditure in real terms. Note that the algebra of the model works equally well when labour taxes are negative, i.e. when labour is subsidized. In this case, G should be interpreted as a lump-sum tax.

The general equilibrium

I consider a symmetric equilibrium, where $L_j = L$ for any j and $Y_i = Y$ for all i. Equilibrium in the goods market implies that production does not fall short of aggregate demand:

$$Y \geq C \tag{35}$$

where $Y = \int_0^1 Y_i \mathrm{d}i$ is aggregate output. Aggregating the individual budget constraint across agents, gives the aggregate accounting identity $PC = WL + D = PY$, implying $Y = C$. Using the cash-in advance constraint, aggregate demand can easily be written as a function of real money balances:

$$Y = \frac{M}{P} \tag{36}$$

In the symmetric equilibrium, the prices of different varieties are equalised, so that Eq. 30 implies:

$$P = \left(\frac{\theta}{\alpha(\theta - 1)}\right)^{\frac{1}{\gamma}} \left(\frac{W}{(1-t)}\right)^{\alpha} \overline{M}^{1-\alpha} \tag{37}$$

The competitive benchmark

In the absence of tax distortions and with perfectly competitive markets for goods and labour, equilibrium is characterized as follows:

$$\begin{aligned} \overline{L} &= \left(\frac{\alpha}{\kappa}\right)^{\frac{1}{2}} \\ \overline{Y} &= \overline{C} = \left(\frac{\alpha}{\kappa}\right)^{\frac{\gamma}{2}} \\ \overline{P} &= \overline{M}\left(\frac{\alpha}{\kappa}\right)^{\frac{-\alpha}{2}} \\ \overline{W} &= \alpha \overline{M}\left(\frac{\alpha}{\kappa}\right)^{\frac{-1}{2}} \end{aligned} \tag{38}$$

where a bar over a variable denotes the competitive level.

The competitive equilibrium is clearly a first best. In order to see why, rewrite agents' utility (26) in terms of output using the identity $Y = C$ and the production function in the symmetric equilibrium, obtaining $U = \ln Y - \frac{\kappa}{2} Y^{\frac{2}{\gamma}}$. It is immediate to verify that the first derivative of the utility function relative to Y is nil for $\mathrm{Y} = (\alpha/\kappa)^{\frac{\gamma}{2}}$ while the second derivative is always negative. This clearly shows that utility is maximized whenever output is at its competitive level.

A useful reduced-form

Consider the log-linear model where all variables are (log) deviations from the competitive standard. To this end, wages, money supply and the tax rate are first decomposed as follows:

$$\begin{aligned} W &= \overline{W} \exp w \\ M &= \overline{M} \exp m \\ 1 - t &= \exp -\tau \end{aligned} \tag{39}$$

where $\overline{M}$ and $\overline{W}$ are the competitive levels derived above while w, m and $\tau \equiv -\log(1 - t)$ capture the deviation from the competitive benchmark. For ease of notation,

lower-case letters denote the log deviation of the corresponding upper-case letter, so that w, for instance, is defined as $w \equiv \log(W) - \log(\overline{W})$. The variable τ provides an obvious exception.

Taking logarithms of Eq. 37, disregarding constants and using Eq. 39 gives:

$$p = (1 - \alpha)m + \alpha(w + \tau) \tag{40}$$

Equation (1) in the text is easily obtained from Eq. 40 after normalising the price level in the previous period to unity. Equation (2) simply obtains from taking logs of Eq. 36 and using Eq. 40 for substituting out p.

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