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Corporatism and macroeconomic stabilization policies

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Corporatism and Macroeconomic Stabilization Policies

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November 9, 2006

Abstract

This paper analyzes corporatism in a two-player game which integrates macroeconomic stabilization policy and a policy of social transfers. The government decides on the level of nominal social transfers, and the trade union decides on the nominal wage level. A central finding is that if one assumes that the trade union's utility not only depends on employment, output and inflation, but also on the level of social transfers, there is always scope for Pareto-improvements, relative to the noncooperative Nash equilibrium. In particular, there always exists a bargained combination of lower wages and higher social benefits that is beneficial for both players. Another important result is that an increase in the degree of inflation aversion of the trade union leads to a lower wage level, a lower level of inflation and a higher level of output. The effect on social transfers depends, among other things, on the degree of inflation aversion of the government. Finally, the paper provides a detailed analysis of when the wage level and the level of social transfers are strategic complements or substitutes for each of the players.

1 Introduction

In this paper we study corporatism in the context of an economic model which integrates issues related to macroeconomic stabilization and issues related to a policy of social transfers. Moreover, although we will assess the effects of corporatism on the macroeconomic performance of an economy, our main contribution consists of a microeconomic analysis of the effects of corporatism on the decisions and utility levels of the corporatist parties. Our approach to corporatism is based on Cubitt's (1995) analysis. While traditionally most researchers use the degree of centralization (Calmfors and Driffill, 1988) or coordination (Soskice,

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1991) of wage bargaining as the main index for corporatism, Cubitt assumes an economy with perfectly centralized wage bargaining, and investigates the effects of several other aspects of corporatism on economic performance. Two such aspects are the views (1) that corporatism exists when the policy game is played cooperatively, and (2) that the degree of corporatism in the economy increases when the inflation aversion of the trade union increases. The former aspect refers to the possibility of achieving Pareto-improvements, starting from a noncooperative Nash equilibrium. This aspect will also be called the scope for corporatism. The latter aspect reflects the view that the trade union's inflation aversion can be interpreted as a measure of corporatism: the more a union internalizes the negative effects of inflation, i.e. the more inflation averse it is, the greater the degree of corporatism in the economy.

In a recent paper Di Bartolomeo et al. (2006) study corporatism in terms of a game between a monopolistic trade union and the government. They conclude that in their model there is no scope for corporatism. More specifically, the trade union can never gain from cooperation. Our present paper shows that this result follows from the very specific model they use. We show that in a more general model there are at least two reasons why the trade union could possibly benefit from corporatism.

First, if the trade union is assumed to be inflation averse, we show that it will benefit from cooperation. Di Bartolomeo et al. (2006) consider a model in which the trade union's utility function is inflation independent. However, Calmfors & Driffill (1988) already emphasized the importance of whether or not wage setters consider the inflationary consequences of their actions. An inflation-averse union may be willing to deliver wage restraint in order to stabilize prices. Cubitt (1995) also takes this possibility into account, and considers an inflation-averse union. His analysis is focused on macroeconomic stabilization issues, and is based on a specific aggregate demand function incorporating the effects of monetary policy. Our analysis specifies a much more general aggregate demand function that takes into account both the budgetary and the social policy of the government.

This social policy of the government is the second reason why the trade union can benefit from corporatism. This argument is absent in Cubitt's framework, and may be of greater empirical importance than the inflation aversion of the trade unions. Given the low inflation rates in the OECD during the last two decades, the inflation aversion of the trade unions was most probably of no great importance in their negotiations with the government. However, if one also incorporates social policy in the model, there is scope for corporatism, even in an economy with an inflation neutral union. This point is stressed e.g. by Mares (2004, 2006) who writes that social policies are a crucial objective for trade unions, which influences their optimal wage demands. She shows that unions, especially during the decades after World War II, have shown willingness to deliver wage restraint in order to expand the welfare state without great costs in terms of unemployment.

This linking of wage determination and social benefits is also crucial in the analysis of Burda (1997). He analyses the interaction between the nominal wage

level and the level of unemployment benefits in a social policy game between the trade union and the government. He concludes that in the Nash equilibrium of the game, corporatism, defined in this context as cooperative play, leads to welfare improvements for both players. His analysis, however, is solely based on a social policy model, not including issues of macroeconomic stabilization. Incorporating such policies in Burda's model will also change his conclusions with respect to the strategic complementarity or substitutability of the level of wages and social benefits.

Summarizing the above discussion, we can say that Cubitt's model lacks social policy, while Burda's model lacks stabilization policy. Our paper aims to incorporate both policies in one model. We consider a game between the government and a monopolistic trade union whose decision variables are, respectively, nominal social benefits and nominal wages. We explicitly model how the determination of the wage level and of social benefits are strategically interrelated. In this model we mainly focus on two questions, which are two essential aspects of corporatism as formulated by Cubitt (1995). First, how sensitive is the Nash equilibrium to changes in the degree of inflation aversion of the trade union? This Nash equilibrium is analyzed both in terms of the target variables output and inflation, and in terms of the decision variables wages and social benefits. The answer is that an increase in the degree of inflation aversion increases output, and decreases inflation and the wage level. The effect on the level of social benefits is ambiguous. Here the question arises whether social benefits and the wage level are strategic complements or substitutes. This issue will be analyzed in detail. Our second research question relates to the scope for corporatism. We will show that in our model delivering wage restraint and providing social benefits will always lead to a Pareto-improvement, relative to the noncooperative Nash equilibrium.

The paper is organized as follows. Section 2 describes the model. It defines the supply and demand side of the output market. After defining the game, the section concludes with the analysis of how the decisions of the government and the trade union affect the equilibrium of the market. Section 3 is the largest part of the paper, and analyzes the first research question mentioned above. It fully describes the Nash equilibrium of the game, both in terms of output and prices and in terms of the wage level and the level of social benefits. We analyze how this equilibrium changes if there is a change in the degree of inflation aversion of one of the players. At the same time, we determine the conditions for wages and social benefits to be strategic complements or strategic substitutes for the players. Section 3 discusses our second research question. It determines the scope for corporatism by examining the Pareto-optimality of the Nash equilibrium. A final section concludes.

2 The Model

In this section we propose a simple short term model to describe the economy. The model consists of a labor market and an output market. On the output

market aggregate demand and supply determine the equilibrium values of output and the price level. We then formally define the game we will analyze in this paper: who are the players, what are the possible actions they can take, and what are their preferences? Finally, we determine how changes in the actions of the players affect aggregate output and the price level.

2.1 The Labor Market

Consider a production function $y = f(n)$, where y is output and n is labor input. We assume that the marginal product of labor $f'(n)$ is positive and decreasing. Let w and p be the nominal wage level and the price level per unit of output, respectively. Consider a representative firm which is a price taker on the labor and the output markets. Profit maximization requires that $\frac{w}{p} = f'(n)$. Labor demand is obtained as $n^d = f'^{-1}(\frac{w}{p}) \equiv g(\frac{w}{p})$. The firm's supply function of output is $y^s = f(n^d) = f(g(\frac{w}{p})) \equiv q(\frac{w}{p})$. From the assumption of decreasing marginal product of labor it follows that $q'(\frac{w}{p}) < 0$. Total population is exogenously given by \bar{n} . We assume that employment is only determined by labor demand, and that $g(\frac{w}{p}) \leq \bar{n}$. Finally, we assume that all workers are unionized. We consider a short term model in which inflation expectations are not taken into account.

2.2 The Output Market

The demand side of the output market consists of the demand for output by the private sector and by the government. Private demand is written as a function $C(p, y_d)$, where y_d is real disposable income. We denote by C_1 and C_2 the partial derivatives of $C(p, y_d)$ with respect to p and y_d . We assume that $C_1 < 0$, and that $0 < C_2 < 1$. The first assumption is motivated by the traditional arguments. First, there is the real balance effect. An increase of p decreases the real value of wealth with a fixed nominal value. This decrease will reduce aggregate demand. Secondly, a rise of p will decrease net exports of a country. Finally, a rise of p reduces the supply of real money. This will increase the interest rate, and reduce aggregate demand. Real disposable income is defined as follows. Wage income is taxed by a tax rate t , $0 < t < 1$. The worker's net real wage is $(1 - t)\frac{w}{p}$. We denote by b the nominal value of social benefits the government pays to a nonworking individual. Examples of such benefits are unemployment benefits, pensions, etc. The total nominal amount spent by the government on these social benefits is $(\bar{n} - g(\frac{w}{p}))b$. Real disposable income is then defined as

$$y_d = (1 - t)\frac{w}{p}g(\frac{w}{p}) + \left(\bar{n} - g(\frac{w}{p})\right)\frac{b}{p} \quad (1)$$

If we denote the government's demand on the output market by G , total aggregate demand is given by $C(p, y_d) + G$. The equilibrium condition on the

output market is given by

$$C(p, y_d) + G - q\left(\frac{w}{p}\right) = 0 \quad (2)$$

We will always assume that the government's budget must be in balance. This requires that

$$t\frac{w}{p}g\left(\frac{w}{p}\right) = G + \left(\bar{n} - g\left(\frac{w}{p}\right)\right)\frac{b}{p} \quad (3)$$

Suppose now that the wage level or the social benefit level change, and that as a result also the price level changes. If then the government wants to restore its budgetary balance, it can do so by adjusting the level of government spending G , or by adjusting the tax rate t . In the main text of this paper we will assume that the government restores its budgetary balance by adjusting G , while keeping t constant. Using (3) we can then write the equilibrium condition (2) as

$$C(p, y_d) + t\frac{w}{p}g\left(\frac{w}{p}\right) - \left(\bar{n} - g\left(\frac{w}{p}\right)\right)\frac{b}{p} - q\left(\frac{w}{p}\right) = 0 \quad (4)$$

At the end of this paper (see section 5) we will discuss briefly how the main results change if one considers the alternative model in which t is used to restore budgetary balance, while keeping G constant.

A more general model, which would reinforce the ideas of this paper, can be obtained by having b include not only the social transfers to the nonworkers, but also social benefits (e.g. health insurance payments, child allowances, etc.) to a certain fraction of the working population $g\left(\frac{w}{p}\right)$. If we denote this fraction by γ , $0 \leq \gamma \leq 1$, real disposable income becomes $(1-t)\frac{w}{p}g\left(\frac{w}{p}\right) + \left[\bar{n} - (1-\gamma)g\left(\frac{w}{p}\right)\right]\frac{b}{p}$. If $\gamma = 0$, we obtain our previous model with y_d as given in (1). If $\gamma = 1$, the total population \bar{n} is paid the same level of social benefits b , independent of being employed or not. One can expect that the union's direct interest in b increases with γ . For reasons of simplicity, we will continue to use the simple model with b including only social transfers to non-workers. One should keep in mind, however, that b could actually be given a much broader interpretation, including more benefits to union members.

2.3 Description of the Game

The game we consider involves two players, the government and the trade union. We assume that the government decides on the level of nominal social benefits, b , taking into account its budget constraint. The trade union has a monopoly on the labor market, and decides on the nominal wage level w . The payoff functions are specified analogous to Cubitt (1995). However, we also incorporate the social policy considerations of the trade union.

Both players are concerned about output performance and inflation. We will assume that the target price level, p^* , is the same for both players. Moreover, we assume that p^* is equal to the price level of a prior period. This implies that

both players have an inflation target of zero. In this way we can talk of prices and inflation interchangeably. The government's output target is given by y_G^* , which is compatible with full employment. Given the government's bliss point (y_G^*, p^*) , its utility function is specified as

$$U^G(y, p) = -\alpha^G(y - y_G^*)^2 - \beta^G(p - p^*)^2 \quad (5)$$

where $\alpha^G, \beta^G \geq 0$, and $\alpha^G + \beta^G = 1$.

With respect to the trade union we assume that it wants to realize a wage premium above the full employment wage. Its output target y_T^* is therefore smaller than y_G^* . The trade union's bliss point in the (y, p) -space is (y_T^*, p^*) . We also assume that the trade union has a direct interest in the level of the social benefits b . This is motivated by the union's concern about the nonworkers' welfare. The trade union's utility function is specified as

$$U^T(y, p, b) = -\alpha^T(y - y_T^*)^2 - \beta^T(p - p^*)^2 + (1 - \alpha^T - \beta^T) b^2 \quad (6)$$

where $\alpha^T, \beta^T \geq 0$ and $\alpha^T + \beta^T \leq 1$.

2.4 Price and output effects of changes in w and b

When the government and the trade union have decided on b and w , we assume that the price level on the output market adjusts so that this market is in equilibrium. We now describe this price adjustment.

Taking w and b as given, we have to solve equation (4) for p . Using (1), equation (4) can be written as

$$C \left[p, (1-t) \frac{w}{p} g\left(\frac{w}{p}\right) + \left(\bar{n} - g\left(\frac{w}{p}\right)\right) \frac{b}{p} \right] + t \frac{w}{p} g\left(\frac{w}{p}\right) - \left(\bar{n} - g\left(\frac{w}{p}\right)\right) \frac{b}{p} - g\left(\frac{w}{p}\right) = 0 \quad (7)$$

Clearly, the value of p that solves this equation depends on w and b . We denote this dependence by the function $p = \phi(w, b)$. In Appendix A we calculate the derivatives $\phi_w(w, b)$ and $\phi_b(w, b)$, representing the price adjustments to changes in the level of wages and social benefits. We assume that the absolute value of the price elasticity of the demand for labor $|\eta|$ is smaller than 1, which is in accordance with empirical estimates of the labor demand function. Furthermore, we assume that $b < w$ and we impose a third restriction with respect to the price and real benefit effects (see inequality (40) in Appendix A). Given these three assumptions, it follows that

$$0 < \frac{w}{p} \phi_w(w, b) < 1 \quad (8)$$

and that

$$\phi_b(w, b) < 0 \quad (9)$$

Inequality (8) states that the elasticity of the equilibrium price level with respect to the nominal wage level is positive and smaller than one. The intuitive

explanation for this is that a nominal wage increase will make labor more expensive, leading to a lower labor demand and a lower supply of output. The resulting excess demand on the output market will cause prices to increase, but less than proportionally. Inequality (9) states that an increase in the nominal benefit level decreases the equilibrium price level. The intuition here is that, given the government's budget constraint, an increase in the nominal benefit level will be accompanied by a decrease in government's consumption level G . As the marginal propensity to consume, C_2 , is assumed smaller than 1, this must decrease aggregate excess demand and subsequently decrease the price level on the output market.

We can now also derive the adjustment of the equilibrium output as a result of changes in w and b . As the equilibrium output level is given by $q(\frac{w}{\phi(w,b)})$, it follows that

$$\frac{\partial q(\frac{w}{\phi(w,b)})}{\partial w} = q'(\frac{w}{p})(\frac{1}{p}) \left[1 - \frac{w}{p} \phi_w(w, b) \right] < 0 \quad (10)$$

and that

$$\frac{\partial q(\frac{w}{\phi(w,b)})}{\partial b} = -q'(\frac{w}{p}) \frac{\phi_b(w, b)}{p} < 0 \quad (11)$$

An increase in the nominal wage level decreases the equilibrium output level. The same is true for an increase in the nominal benefit level. The intuition here is clear from the discussion of (8) and (9) above.

3 The Nash equilibrium

The Nash equilibrium (NE) of the game can be determined in two different spaces: the (y, p) -space and the (w, b) -space. The approach in the (y, p) -space is useful when assessing the effects of corporatism on output and inflation. The approach in the (w, b) -space can be used in assessing the microeconomic effects of corporatism on the decision variables b and w . Cubitt's analysis (1995) focuses entirely on the (y, p) -space. In subsection 3.1 we apply this approach. In subsection 3.2 we translate the results in the (y, p) -space to the (w, b) -space.

In order to find the NE, both subsections will start by determining the reaction functions of both players. In the (w, b) -space, this will allow us to derive conditions under which w and b are strategic complements or substitutes for the players. After finding the NE, we analyze the effects on this NE of an increase of corporatism, defined as an increase of the degree of inflation aversion of the trade union (β^T).

3.1 Nash equilibrium in the (y, p) -space

We will first derive the "quasi-best-reply-loci" of the government and of the trade union. We then study the NE. Finally, we investigate how this equilibrium changes when the inflation aversion of the trade union changes.

3.1.1 The Government's Quasi-Best-Reply-Locus

We first introduce the set of all possible equilibrium combinations (y, p) the government can attain by manipulating b , taking any value of w as given. This set is formally defined as

$$A^G(w) = \left\{ (y, p) \mid y = q\left(\frac{w}{\phi(w, b)}\right), p = \phi(w, b) \text{ for } b \geq 0 \right\} \quad (12)$$

Note that, for any given value of w , this set coincides with the aggregate supply curve $y = q(\frac{w}{p})$. In this supply function we take the wage level w as given, while changes in b cause changes in p through the function $p = \phi(w, b)$.

Figure 1: Nash Equilibrium (p, y) -space

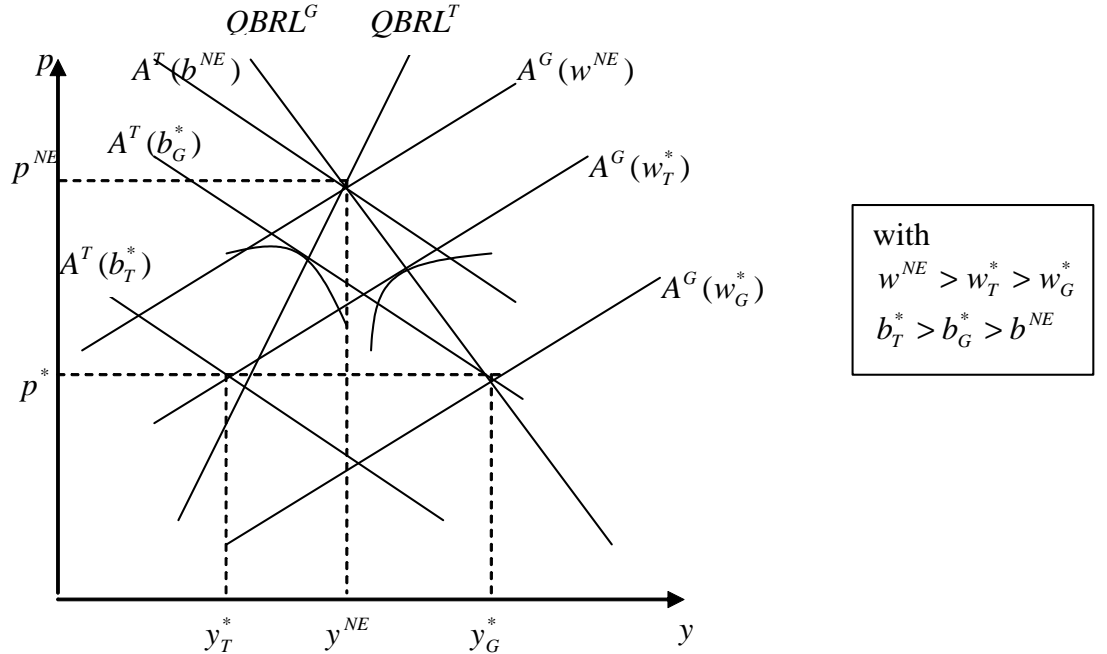


Figure 1 gives several examples of sets (or curves) $A^G(w)$, for different values of w . As $q'(\frac{w}{p}) < 0$, the curve $A^G(w)$ shifts to the North as w increases. As increases of b decrease the price level p (see (9)), increases of b move the point (y, p) to the South-West along a given supply curve. The slope of such a supply curve can be obtained by totally differentiating the equations $\begin{cases} y = q(\frac{w}{\phi(w, b)}) \\ p = \phi(w, b) \end{cases}$, for a given value of w , and solving for $\frac{dp}{dy}$. This yields the slope

$$\frac{dp}{dy} = -\frac{1}{q'(\frac{w}{\phi(w,b)})\frac{w}{p^2}} > 0 \quad (13)$$

We now analyze the decision problem of the government. Using the equilibrium values $y = q(\frac{w}{\phi(w,b)})$ and $p = \phi(w,b)$, the government's utility function in (5) can be rewritten as

$$\pi^G(w,b) = -\alpha^G \left[q\left(\frac{w}{\phi(w,b)}\right) - y_G^* \right]^2 - \beta^G [\phi(w,b) - p^*]^2 \quad (14)$$

The government's problem can then be stated as

$$\underset{b}{Max} \pi^G(w,b) \quad (15)$$

The FOC for this problem is given by

$$-\frac{\alpha^G(y - y_G^*)}{\beta^G(p - p^*)} = -\frac{1}{q'(\frac{w}{p})\frac{w}{p^2}} \quad (16)$$

where $y = q(\frac{w}{\phi(w,b)})$ and $p = \phi(w,b)$. It is clear that the LHS of this FOC represents the slope of the utility function (5) in the (y, p) -space. From (13) we know that the RHS can be interpreted as the slope of the curve $A^G(w)$. It follows that we can interpret (16) as the FOC of the problem

$$\underset{y,p}{Max} U^G(y,p) \quad s.t. (y,p) \in A^G(w) \quad (17)$$

The solution of this problem is characterized by condition (16): at the optimal point (y, p) , the slope of the government's indifference curve equals the slope of the constraint $A^G(w)$. Problem (17) and the optimality condition (16) are illustrated on Figure 1.

Solving problem (17) for various values of w , we obtain the locus of corresponding solutions. Following Cubitt (1995) we call this locus the Quasi-Best-Reply-Locus of the government, abbreviated as $QBRL^G$. It is a best reply function for the government defined in the (y, p) -space, and not - as is common - in the (w, b) -space. Note that increases of w shift the locus $A^G(w)$ to the North. This causes a movement of the optimum (y, p) to the North-West along the $QBRL^G$. It follows that the government's maximal attainable utility will always decrease as w increases.

3.1.2 The Trade Union's Quasi-Best-Reply-Locus

Similarly to (12), we can define the set of all equilibrium combinations (y, p) which the trade union can attain by manipulating w , for any given value of b . We denote this set by $A^T(b)$, which is formally defined as

$$A^T(b) = \left\{ (y, p) \mid y = q\left(\frac{w}{\phi(w,b)}\right), p = \phi(w,b) \text{ for } w \geq 0 \right\} \quad (18)$$

In Cubitt's model (1995) this set coincides with the aggregate demand function. In our model this is no longer true. The introduction of the locus $A^T(b)$ is a significant generalization of Cubitt's analysis. Let us first determine the slope of the curve defined by $A^T(b)$. Totally differentiating the equations $\begin{cases} y = q(\frac{w}{\phi(w,b)}) \\ p = \phi(w,b) \end{cases}$, with b given, and solving for $\frac{dp}{dy}$ yields the slope

$$\frac{dp}{dy} = \frac{\phi_w(w,b)}{q'(\frac{w}{\phi(w,b)}) \left(\frac{p-w\phi_w(w,b)}{p^2} \right)} < 0 \quad (19)$$

The intuition behind this negative slope is easy to understand. Take b as given, and consider the effects of an increase of w . From (8) it follows that this will increase the equilibrium price level p . As the elasticity of the equilibrium price level p with respect to the wage level w is smaller than one (see again (8)), the real wage $\frac{w}{p}$ will increase. This will decrease the demand for labor and the equilibrium level of output. Hence, for a given value of b , an increase of w will increase the equilibrium price level p , and decrease the equilibrium output level y . Moreover, an increase of b will shift the curve defined by $A^T(b)$ to the South. Indeed, at any given level of w and p , an increase of b will cause a decrease of the government's demand for output G . This follows from the government's budget constraint (3). This will lower the equilibrium level of output. Figure 1 gives several examples of curves $A^T(b)$, for various values of b .

Using the equilibrium values $y = q(\frac{w}{\phi(w,b)})$ and $p = \phi(w,b)$, the trade union's utility function (6) can be written as

$$\pi^T(w,b) = -\alpha^T \left[q\left(\frac{w}{\phi(w,b)}\right) - y_T^* \right]^2 - \beta^T [\phi(w,b) - p^*]^2 + (1 - \alpha^T - \beta^T) b^2 \quad (20)$$

The trade union's problem is then

$$\underset{w}{Max} \pi^T(w,b) \quad (21)$$

The FOC for this problem is given by

$$-\frac{\alpha^T (y - y_T^*)}{\beta^T (p - p^*)} = \frac{\phi_w(w,b)}{q'(\frac{w}{\phi(w,b)}) \left(\frac{p-w\phi_w(w,b)}{p^2} \right)} \quad (22)$$

where $y = q(\frac{w}{\phi(w,b)})$ and $p = \phi(w,b)$. The LHS of (22) represents the slope of the utility function (6) in the (y,p) -space. By (19) the RHS of (22) can be interpreted as the slope of the curve $A^T(b)$. It is clear that we can interpret (22) as the FOC of the problem

$$\underset{y,p}{Max} U^T(y,p), \quad s.t. \quad (y,p) \in A^T(b) \quad (23)$$

Condition (22) then requires that, at the optimal point (y,p) , the slope of the trade union's indifference curve equals the slope of the curve $A^T(b)$. Problem (23) and the optimality condition (22) are illustrated on Figure 1.

Solving problem (23) for various values of b , we obtain the locus of corresponding solutions. Again following Cubitt (1995), we call this locus the Quasi-Best-Reply-Locus of the trade union, abbreviated as $QBRL^T$. It is a best reply function of the trade union, defined in the (y, p) -space. Note that decreases of b move the curve $A^T(b)$ to the North. This causes a movement of the optimum (y, p) to the North-East along the $QBRL^T$. As a result of such a movement, the maximal attainable utility of the trade union will always decrease as b decreases.

3.1.3 Nash equilibrium

The NE can now easily be obtained as the intersection of $QBRL^G$ and $QRLB^T$. This is illustrated on Figure 1. The figure shows that in our model the NE (y^{NE}, p^{NE}) will always satisfy

$$\begin{cases} y_T^* < y^{NE} < y_G^* \\ p^{NE} > p^* \end{cases} \quad (24)$$

Note that $p^{NE} > p^*$, even though there is unanimity among the players about the target value p^* .

3.1.4 Sensitivity of the Nash equilibrium with respect to β^T .

We now determine the effects of an increase of the degree of inflation aversion of the trade union, β^T , on the NE (y^{NE}, p^{NE}) . This is an important question. As we have stated in the introduction, the trade union's degree of inflation aversion can be interpreted as a possible degree of corporatism in an economy. See Cubitt (1995).

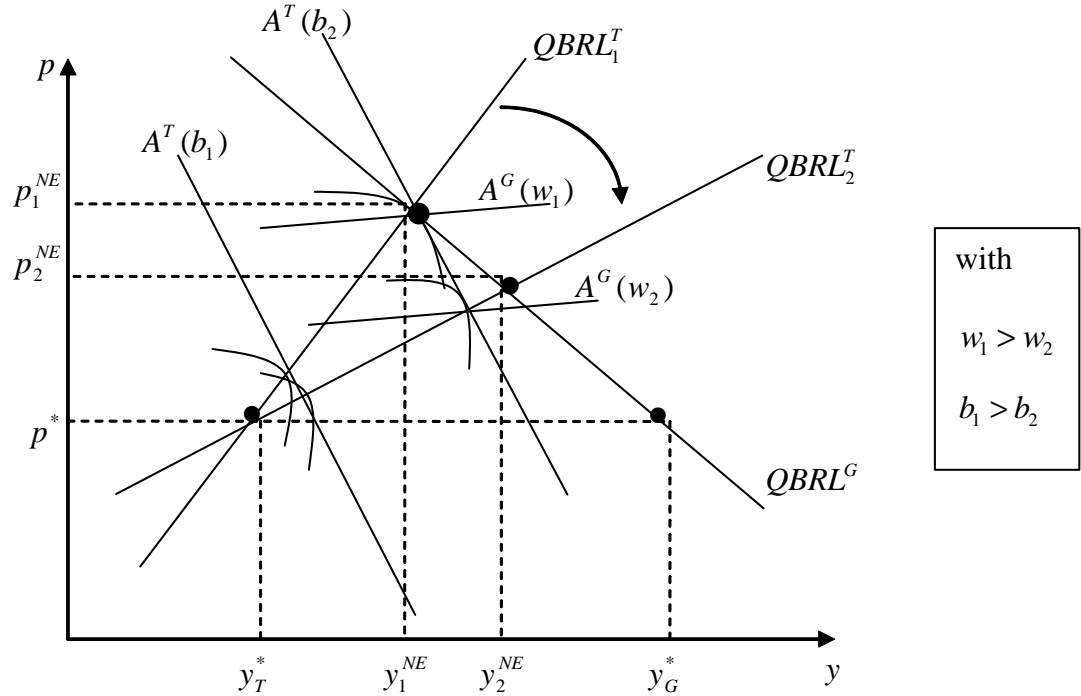
Clearly, an increase of β^T leaves the $QBRL^G$ unaffected. It does, however, affect the location of the $QRLB^T$. Figure 2 illustrates what happens.

Start at any combination (y, p) on the original $QRLB^T$, denoted by $QRLB_1^T$. If β^T increases, the slope of the trade union's indifference curve through this point will increase. The slope of the curve $A^T(b)$ is not affected by the change in β^T . It follows that, due to the increase of β^T , the new optimal point on the curve $A^T(b)$ will be to the right of the original optimal point. The whole $QBRL^T$ rotates clockwise around the point (y_T^*, p^*) from $QBRL_1^T$ to $QBRL_2^T$. The effects of an increase of β^T on the NE are now clear. If the inflation aversion of the trade union increases, the NE shifts from (y_1^{NE}, p_1^{NE}) to (y_2^{NE}, p_2^{NE}) . This implies a lower value of p^{NE} , and a higher value of y^{NE} . Both effects increase the utility level of the government. The following proposition summarizes our discussion.

Proposition 1 *If β^T increases, y^{NE} increases and p^{NE} decreases.*

This result confirms the result of Cubitt (1995): the higher the value of β^T (and thus the more corporatist the behavior of the union), the more the union will internalize the negative effects of inflation and the better - according to the government ! - will be the macroeconomic performance of the economy.

Figure 2: Sensitivity of (y^{NE}, p^{NE}) to an increase in β^T



Obviously, a similar analysis can be made on the effects of an increase of β^G . In this case the $QBRL^G$ will rotate anticlockwise around the point (y_G^*, p^*) . In the new NE the price level p^{NE} will be lower, while the output level y^{NE} will decrease. The trade union's utility will increase.

3.2 Nash equilibrium in the (w, b) -space

In this subsection we want to characterize the foregoing NE (y^{NE}, p^{NE}) and its sensitivity to changes in β^T in the (w, b) -space. As we are interested in the effects of corporatism on macro-economic policy, it is important to know how corporatism affects the government's reaction to a change in w , and the trade union's reaction to a change in b . To a large extent, this analysis is lacking in Cubitt (1995). This analysis in the (w, b) -space will also improve our understanding of what happens in the (y, p) -space.

3.2.1 Best-Reply-Function of the Government

The best-reply-function of the government will be denoted by $b = b(w)$. It specifies for each level of w the corresponding best value of b , i.e. the value of b that solves problem (15). An important question relates to the sign of the slope of the function $b(w)$: if the trade union would increase its wage demand w , would the government then react by increasing or decreasing the level of b ? In other words, are w and b strategic complements or substitutes for the government? In his social policy model, Burda (1997) relates the slope of $b(w)$ to the preferences of the government. However, his analysis remains unclear about the exact conditions that determine the slope of the government's best-reply-function.

On Figure 1 it is easy to see that in our model the slope of $b(w)$ depends critically on whether the curve $A^T(b)$ cuts the $QBRL^G$ from below or from above. If the curve $A^T(b)$ cuts the $QBRL^G$ from below, then increases of w - causing an upward movement along the $QBRL^G$ - lead to lower values of b , so that the slope of $b(w)$ is negative. In this case the two instruments w and b are strategic substitutes for the government. Similarly, if the locus $A^T(b)$ cuts the $QBRL^G$ from above, the slope of $b(w)$ is positive, and the two instruments are strategic complements for the government. The foregoing graphical arguments are made more rigorous in Appendix B. There it is shown that

$$\text{Slope } b(w) \geq 0 \iff |\text{Slope } QBRL^G| \leq |\text{Slope } A^T(b)| \quad (25)$$

The slope of the curve $A^T(b)$ is given by (19), while the slope of the $QBRL^G$ is given by (44) in Appendix B. These two slopes are complicated expressions: they depend on $\phi_w(w, b)$ and $\phi_b(w, b)$ which themselves are rather complicated. One of the variables affecting the slope of the $QBRL^G$ is the degree of inflation aversion of the government, β^G . We have seen in subsection 3.1.4 that increasing the value of β^G rotates the $QBRL^G$ anticlockwise around the point (y_G^*, p^*) . One can expect that for a sufficiently high value of β^G the curve $A^T(b)$ cuts the $QBRL^G$ from above, so that $|\text{Slope } QBRL^G| < |\text{Slope } A^T(b)|$. The two instruments are then strategic complements. For sufficiently low values of β^G , the two instruments are strategic substitutes. Equivalence (25) then leads to the following result.

Proposition 2 *If β^G is sufficiently high (low), then b and w are strategic complements (substitutes) for the government*

The intuitive explanation of this dependence of the slope of $b(w)$ on β^G is straightforward. An increase in w will lower output and increase the price level on the output market. See (10) and (8). If the government cares very strongly about inflation relative to output, it will react to these changes by increasing the value of b and lowering its demand G on the output market. (11) and (9) show that this will indeed dampen the effect on inflation and accentuate the effect on output of the increase in w . On the other hand, if the government

cares relatively more about employment, it will react to an increase of w by decreasing b and increasing G .

Finally, we can identify one point (w, b) which must certainly lie on the government's best-reply-function. Let (w_G^*, b_G^*) represent the combination (w, b) that leads to the government's bliss point (y_G^*, p^*) in the (y, p) -space. In other words, (w_G^*, b_G^*) is defined as the combination of (w, b) such that the two curves $A^G(w_G^*)$ and $A^T(b_G^*)$ intersect in the point (y_G^*, p^*) in the (y, p) -space (see Figure 1). These values of w and b must satisfy $b_G^* = b(w_G^*)$.

3.2.2 Best-Reply-Function of the Trade Union

The trade union's best-reply-function will be denoted by $w = w(b)$. It is obtained by solving problem (21). In his social policy model, Burda (1997) obtains an unambiguously upward sloping best-reply-function for the trade union. However, his model does not consider stabilization policy goals for the union, in terms of output and inflation.

From Figure 1 it is clear that in our model, analogous to section 3.2.1, decreasing values of b will lead to increasing or decreasing values of w , depending on whether the curve $A^G(w)$ cuts the $QBRL^T$ from above or from below. In Appendix C we show rigorously that

$$\text{Slope } w(b) \gtrless 0 \iff \text{Slope } QBRL^T \lesseqgtr \text{Slope } A^G(w) \quad (26)$$

Again, the slopes of $QBRL^T$ and of $A^G(w)$ are complicated expressions, but we are most interested in the importance of the degree of inflation aversion β^T of the trade union. We have seen in subsection 3.1.4 that increasing the value of β^T rotates the $QBRL^T$ clockwise around the point (y_T^*, p^*) . For sufficiently high values of β^T , one can expect that $\text{Slope } QBRL^T < \text{Slope } A^G(w)$, so that the two instruments are strategic complements. For sufficiently low values of β^T , the two instruments are strategic substitutes for the trade union. The following proposition then follows.

Proposition 3 *If β^T is sufficiently high (low), then b and w are strategic complements (substitutes) for the trade union.*

The intuition here is also straightforward. Suppose the government decides to decrease b , and to increase G . If then the trade union is very inflation averse, it will reply by lowering its wage claim w to avoid inflationary pressures.

Finally, we can identify the combination (w_T^*, b_T^*) such that the intersection in the (y, p) -space of the two curves $A^G(w_T^*)$ and $A^T(b_T^*)$ occurs in the trade union's bliss point (y_T^*, p^*) (see Figure 1). These values of w and b lie on the best-reply-function of the trade union, and must satisfy $w_T^* = w(b_T^*)$.

3.2.3 Nash equilibrium

Propositions 2 and 3 imply that we can distinguish four different cases in determining a NE in the (w, b) -space, depending on the slopes of the best-reply-functions $b(w)$ and $w(b)$. Let us define a player's inflation aversion as "High"

("Low") if for that player the two instruments are strategic complements (substitutes). We denote these cases by β_{High}^G and β_{High}^T (β_{Low}^G and β_{Low}^T). Figure 3 illustrates the nature the NE for each of the four possible cases.

Note that in the case of similar preferences, $(\beta_{Low}^T, \beta_{Low}^G)$ and $(\beta_{High}^T, \beta_{High}^G)$, the slopes of $w(b)$ and $b(w)$ have the same sign. Moreover, it is easy to verify that in this case $w(b)$ will always be steeper in absolute value than $b(w)$. Figure 1 can be used to show this for the case $(\beta_{Low}^T, \beta_{Low}^G)$. For the union, the optimal change in w following a change in b will always be smaller than would be optimal for the government. Considering the figure for the case $(\beta_{High}^T, \beta_{High}^G)$ would yield the same conclusion. In the case of dissimilar preferences, $(\beta_{Low}^T, \beta_{High}^G)$ and $(\beta_{High}^T, \beta_{Low}^G)$, the slopes of $w(b)$ and $b(w)$ have different signs.

It is also interesting to investigate the stability of the NE. It is well known that Nash Equilibria of the type given in Figure 3 are locally stable if and only if the product of the absolute values of the slopes of the best-reply-functions of the players is smaller than one, i.e. $|b'(w^{NE})| |w'(b^{NE})| < 1$ (see, e.g., Di Bartolomeo and Pauwels, 2006). Using the argument of the previous paragraph, we can conclude that the NE (w^{NE}, b^{NE}) is always locally stable in case the players' preferences are similar. A NE can fail to be stable only if preferences are dissimilar.

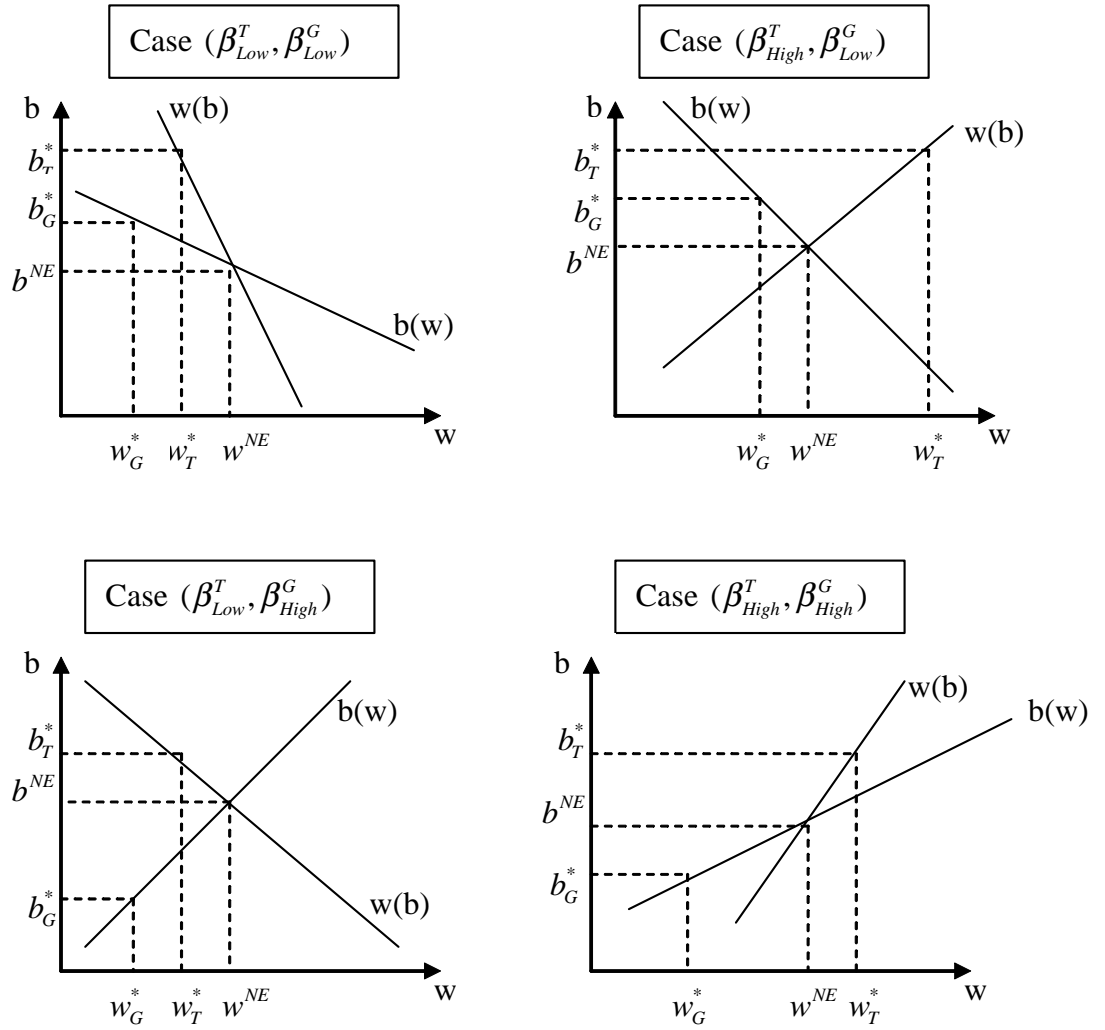
3.2.4 Sensitivity of the Nash equilibrium with respect to β^T

Section 3.1.4 made clear that an increase of β^T changes the NE (y^{NE}, p^{NE}) . This change requires a change of the players' optimal decisions (w^{NE}, b^{NE}) . This section analyzes the changes in the (w, b) -space caused by an increase in β^T . We will see that, in contrast to the effects in the (p, y) -space, the sign of the effects in the (w, b) -space do depend on the preferences of the government. More specifically, they depend on whether β^G is "Low" or "High".

An increase of β^T will leave $b(w)$ unchanged, but it will cause $w(b)$ to rotate clockwise around (w_T^*, b_T^*) . This result can again be derived from the (p, y) -space, for each of the four cases. As an example, consider the case β_{Low}^T , which is illustrated on Figure 2. At each level of b , the optimal w of the union decreases if β^T increases (compare (w_1, b_2) with (w_2, b_2)). The negatively sloped $w(b)$ will become steeper. Analogously, one can show that for the case β_{High}^T , at each level of b , the optimal w of the union increases with β^T . The positively sloped $w(b)$ will become flatter.

Figure 4 shows, for each of the four cases, what happens to the NE in the (w, b) -space if β^T increases. The figure makes it clear that the sign of the effect of β^T on w^{NE} does not depend on the case considered. It will always be negative. A union which is more inflation averse will moderate its wage claims. The effect on b^{NE} , however, depends on β^G . If β^G is "Low", b^{NE} will increase if β^T increases. If β^G is "High", b^{NE} will decrease if β^T increases. The intuition for this different reaction by the government has already been made clear in section 3.2.1. Table 2 summarizes the effects of an increase in β^T on $(w^{NE},$

Figure 3: Nash Equilibrium (w, b) -space



b^{NE}).

Table 2: Effects of an increase of β^T on (w^{NE}, b^{NE})

	β_{Low}^G	β_{High}^G
w^{NE}	–	–
b^{NE}	+	–

Note that our model unambiguously predicts, for any given value β^G , the effects of an increase in β^T on w^{NE} and b^{NE} . However, the effects on the replacement ratio $\frac{b}{w}$ are not always clear. For the two cases where β_{Low}^G applies, the replacement ratio will increase. However, in the cases where β_{High}^G applies, we cannot predict the effect on $\frac{b}{w}$. In these latter cases, b and w change in the same direction, and our analysis does not allow us to make statements about the magnitudes of the changes in b and w .

To summarize, the theoretical discussion in section 3 predicts that an increase of the degree of inflation aversion of the trade union leads to a decrease of inflation, an increase of output and a decrease of nominal wages in the NE, whatever the degree of inflation aversion of the government. In addition, an increase of β^T leads to an increase of social transfers in countries where β^G is low, and to a decrease of social transfers when β^G is high.

4 Scope for Corporatism

According to Cubitt (1995), one possible interpretation of corporatism is that players play the economic policy game cooperatively. Following Di Bartolomeo et al (2006), there is scope for corporatism if, starting from the noncooperative NE, cooperation could increase the payoffs of all the players. Put differently, there can only be scope for corporatism if the NE is not Pareto efficient. In the model studied by Di Bartolomeo et al (2006) the authors conclude that the NE is Pareto efficient, so that there is no scope for corporatism. However, as we will show in this section, this result is based on a very specific model, in which the trade union is not inflation averse and in which social policy is not considered. Using the more general model of the previous sections we will show that there is always scope for corporatism.

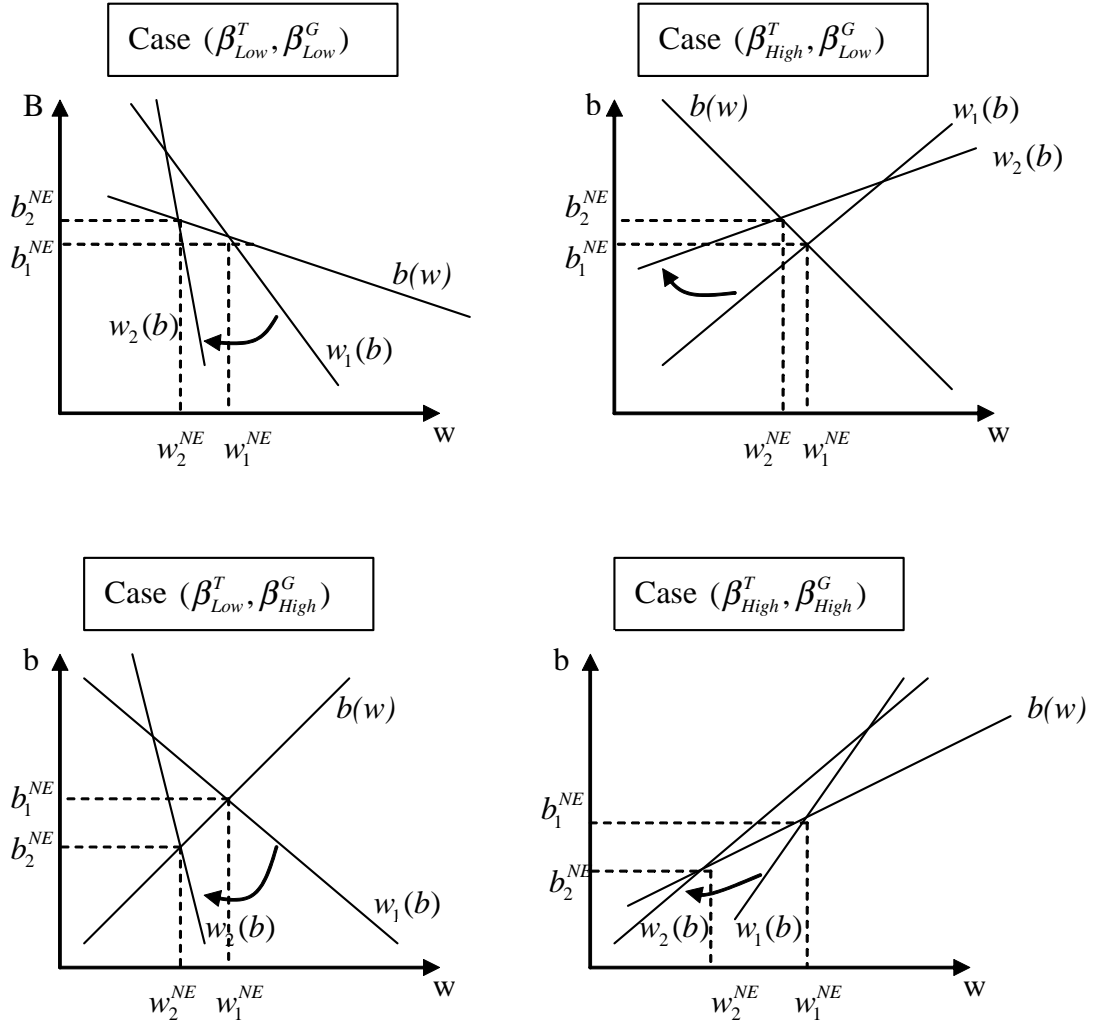
To see whether in our model the NE is Pareto efficient, we calculate the derivatives $\frac{\partial \pi^T(w,b)}{\partial b}$ and $\frac{\partial \pi^G(w,b)}{\partial w}$, and evaluate them in the NE. If at least one of these derivatives is non-zero, the NE is not Pareto efficient. The pay-off of at least one player could then be increased, without decreasing the other player's payoff. Using (14) we can calculate

$$\frac{\partial \pi^G(w,b)}{\partial w} = -2\alpha^G(y - y_G^*)q' \left(\frac{w}{\phi(w,b)} \right) \frac{p - w\phi_w(w,b)}{p^2} - 2\beta^G(p - p^*)\phi_w(w,b)$$

Using (24), we see that this derivative is always negative in the NE, so that

$$\frac{\partial \pi^G(w^{NE}, b^{NE})}{\partial w} < 0 \tag{27}$$

Figure 4: Sensitivity of (w^{NE}, b^{NE}) to an increase in β^T



Wage moderation always increases the government's payoff, relative to the NE: it leads to a higher output and to lower inflation. This same result also follows from Figure 1: a decrease of w shifts the locus $A^G(w)$ to the South-East, thereby increasing the government's utility.

We also have

$$\frac{\partial \pi^T(w, b)}{\partial b} = -2\alpha^T(y - y_T^*)q'\left(\frac{w}{\phi(w, b)}\right)\frac{-w\phi_b(w, b)}{p^2} - 2\beta^T(p - p^*)\phi_b(w, b) + 2(1 - \alpha^T - \beta^T)b$$

Using again (24), this derivative is always positive in the NE. Hence,

$$\frac{\partial \pi^T(w^{NE}, b^{NE})}{\partial b} > 0 \quad (28)$$

Relative to the NE, the trade union would be better off if the government would increase the level of social benefits. An increase of b contributes to a lower output (and an associated increase of the real wage level) and lower inflation. There is also a positive direct welfare effect of an increase of social transfers. Note that (28) still holds in case the union is not inflation averse, i.e. $\beta^T = 0$.

(27) and (28) make clear that, relative to the NE, a combination of wage moderation and an expansion of social benefits would increase the payoff of both players. Therefore, the NE is not Pareto-efficient, and there is always scope for corporatism.

The scope for Pareto improvements in the NE can also be seen graphically on Figure 5. The dashed area on this figure contains all combinations (w, b) which increase the payoff of both players, relative to the NE.

We can conclude that in our model a union is always motivated for reaching a cooperative agreement, even if it is not inflation averse. The threat of the government to keep the level of social benefits as low as b^{NE} if the trade union sticks to its high wage demand w^{NE} , will make the union willing to negotiate. The union is willing to offer wage restraint in exchange for higher social transfers.

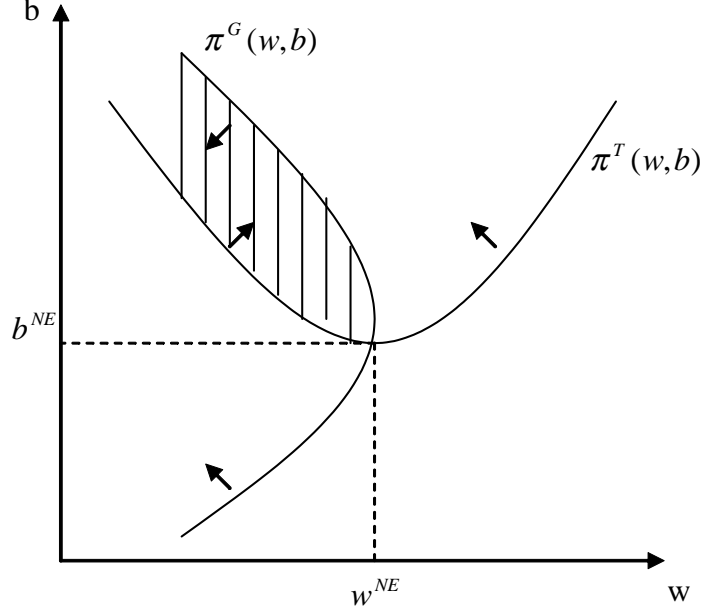
5 Endogeneous Tax Rates

Up to now we assumed that after changes in the wage or social benefit level the government restores its budgetary balance by adjusting the level of its purchases G . The tax rate t was assumed to remain constant. However, it is possible that the government prefers to keep its level of purchases G constant, and that it adjusts the tax rate t to restore the budgetary balance. This section discusses this alternative model. As a matter of convenience, we will denote the first model by Case 1, and the alternative model by Case 2.

The most fundamental difference between both models is the independency of the equilibrium on the output market of the level of social benefits b . The equilibrium condition on the output market in Case 2 is given by

$$C \left[p, \frac{w}{p}g\left(\frac{w}{p}\right) - G \right] + G - q\left(\frac{w}{p}\right) = 0 \quad (29)$$

Figure 5: Scope for Corporatism



It is clear that in this case the value of p that solves this equilibrium equation only depends on w , not on b as in Case 1 (See (7)). We denote this equilibrium price function as $p = \phi_2(w)$. As in Case 1, we can calculate the derivatives $\phi_{2w}(w)$ and $\phi_{2b}(w)$, representing the equilibrium price adjustments to changes in the level of wages and social benefits. We then obtain

$$0 < \frac{w}{p} \phi_{2w}(w) < 1 \quad (30)$$

and (trivially)

$$\phi_{2b}(w) = 0 \quad (31)$$

The adjustment of the equilibrium output in Case 2 as a result of changes in w and b is given by

$$\frac{\partial q(\frac{w}{\phi_2(w)})}{\partial w} = q'(\frac{w}{p})(\frac{1}{p}) \left[1 - \frac{w}{p} (\phi_2)_w(w) \right] < 0 \quad (32)$$

and

$$\frac{\partial q(\frac{w}{\phi_2(w)})}{\partial b} = 0 \quad (33)$$

Compare (30) and (32) with (8) and (10), respectively. Although $\phi_{2w}(w)$ will in general ¹differ from $\phi_w(w, b)$, prices and output in both cases are sensitive to changes in w , and the sensitivity works in the same direction. The most important difference between the two models lies in the sensitivity of the equilibrium on the output market to changes in b . To see this, compare (31) and (33) with (9) and (11), respectively. It is clear that in Case 2, the equilibrium on the output market is totally independent of b . To understand the intuition of this, compare the effects of an increase in b between the two models. In both models, the winners of this change are the non-workers, since their disposable incomes increase. The losers, however, are different in the two cases. In Case 1 the government loses because it decreases the amount of its purchases G by an amount equal to the increased amount of the non-workers' disposable income. The workers are not affected by this measure. Given that the citizens' marginal propensity to consume is between 0 and 1, the negative effect on aggregate demand of the decrease in G is higher than the positive effect on aggregate demand of the increase in disposable income of the private sector. Therefore, in Case 1, aggregate demand and prices decrease as b increases. In Case 2, the workers are the losers because they have to pay higher taxes in order to finance the non-workers' increase in disposable income. In this case, the government is unaffected. Given the assumption that the marginal propensities to consume of workers and non-workers are equal, the effect of an increase in b on total aggregate demand is zero. The increased demand of non-workers is totally compensated by the decreased demand of the working population.

The fact that the equilibrium on the output market in Case 2 does not depend on b has important implications for the game we consider. The government is now no longer able to influence output and prices by changing the level of b . The trade union, however, still has the power to influence these variables by changing w . Clearly, this reduces the government's relative power in the game. Changes in the equilibrium values of y and p , caused by changing wage claims of the trade unions, can no longer be offset by changing levels of b . As a consequence, the government in Case 2 has no control at all over its own payoff function (5). The trade union now has the monopoly power over stabilization policy. The set $A^T(b)$, defined in (18) is independent of b , and is given by a single line in the (y, p) -space. If we then assume that $(y_T^*, p^*) \in A^T$, the trade union is perfectly able to choose the wage level w so that it realizes its bliss point (y_T^*, p^*) . This is now the NE in the (y, p) -space. This is illustrated on Figure 6. Note that $A^G(w)$ (see (12)) in case 2 only consists of a single point for each level of w . Also note that the locus $QBRL^G$ disappears in Case 2. As already noted, the set $A^T(b)$ is independent of b , and is denoted by A^T . The locus $QBRL^T$ now coincides with the bliss point (y_T^*, p^*) . Given that the government has no power in Case 2 to influence the NE, its bliss point (y_G^*, p^*) is a feasible combination of y and p only if it equals the bliss point (y_T^*, p^*) of the trade union.

¹One can show that $\phi_w(w, b) \geq \phi_{2w}(w) \Leftrightarrow t \geq \frac{b}{w} \frac{|\eta|}{(1-|\eta|)} - \frac{(\bar{n}-g(\cdot))}{g(1-|\eta|)} \frac{b}{p} \frac{\phi_{2w}(w)}{(1-\frac{w}{p} \phi_{2w})}$

Figure 6: Nash Equilibrium (p, y) -space case 2

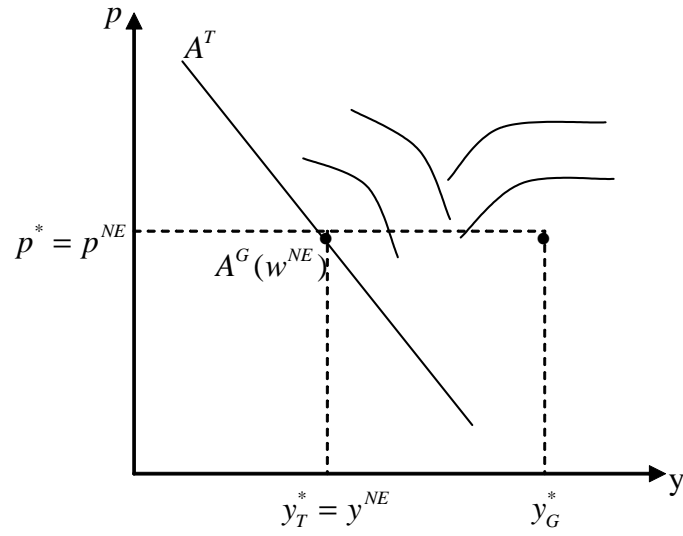


Figure 7: Nash Equilibrium (w, b) -space case 2

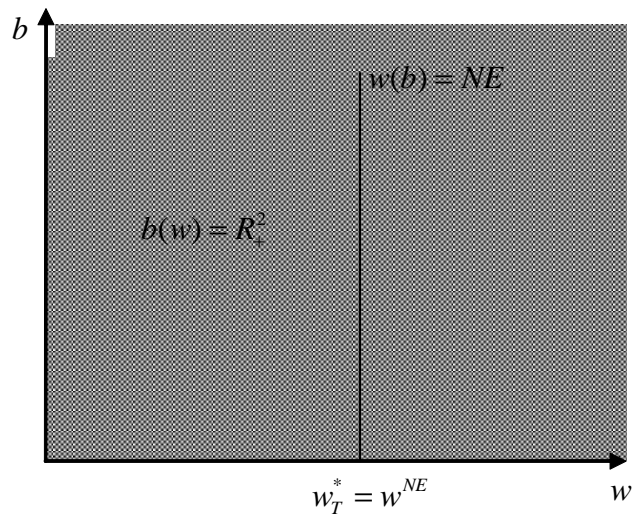
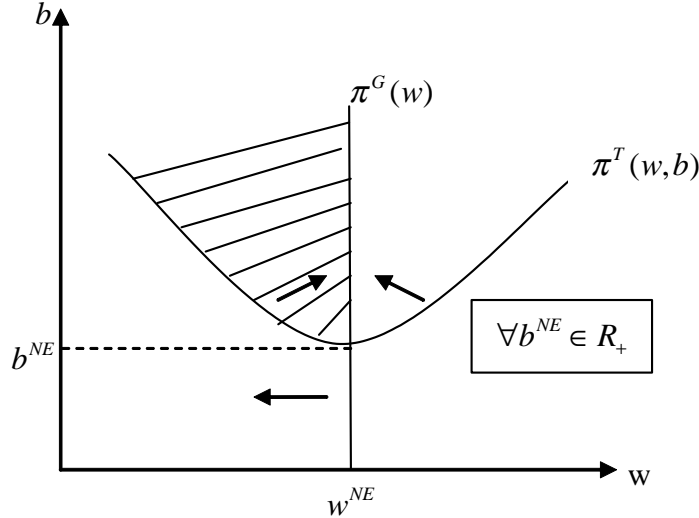


Figure 7 represents the NE in the (w, b) -space for Case 2. This figure should be compared with Figure 3. Whereas we have four possible figures in Case 1 depending on the relative inflation aversion of the players, there is only one possible figure for Case 2. Since the payoff of the government is independent of b , the reaction correspondence of this player consists of the entire space R_+^2 . As is clear from the discussion above, the reaction curve of the trade union, $w(b)$, must be a vertical line positioned at w^* , i.e. the value of w that leads to (y_T^*, p^*) . At the same time $w(b)$ is the set of all NE in the (w, b) -space of Case 2.

One important result is that in Case 2, contrary to Case 1, a change in the degree of inflation aversion of the players does not change the NE, neither in the (p, y) - nor in the (w, b) - space. The reason is that the trade union in Case 2 is not faced with a trade-off between its output and inflation goals, y_T^* and p^* . It is perfectly able to achieve *both* targets since it has the monopoly power over stabilization policy. Therefore, the relative weight this player assigns to its targets is not relevant. Neither does the NE depend on the government's relative degree of inflation aversion, simply because this player can never influence the NE in Case 2.

Figure 8: Scope for Corporatism Case 2



Another important result is that, although the government does not have any power regarding stabilization policy, it still has the power to influence the payoff function of the trade union through social policy (see (6)). A higher level of b increases the payoff of the trade union:

$$\frac{\partial \pi^T(w, b)}{\partial b} = 2(1 - \alpha^T - \beta^T)b > 0 \quad (34)$$

Moreover, the payoff of the government remains sensitive to changes in w . A lower level of w would increase the government's payoff.

$$\frac{\partial \pi_2^G(w)}{\partial w} = -2\alpha^G(y - y_G^*)q'\left(\frac{w}{\phi(w, b)}\right)\frac{p - w\phi_w(w, b)}{p^2} < 0 \quad (35)$$

Inequalities (34) and (35) show that the scope for corporatism remains, also in Case 2. This can also be seen graphically on Figure 8.

6 Conclusions

In this paper, following Cubitt (1995), we focused on two characteristics of corporatism. An economy is said to be more corporatist (1) if the trade union is more inflation averse, and (2) if all the policy makers can gain by cooperating with each other. This approach led us to the following two research questions. First, how will changes in the degree of inflation aversion of the trade union affect the performance of the economy? And secondly, what determines the extent to which the government and the trade union can benefit from cooperation?

To analyze these questions we developed a model that integrates macroeconomic stabilization and social policy. There are two policy makers, the government and the trade union. The government determines the level of social benefits, while the trade union determines the level of nominal wages. Following a change in the level of social benefits, the government is assumed to restore budgetary balance either by adjusting its expenditures on the output market, or by adjusting the tax rate. Both policy makers care about output, employment and inflation. Moreover, the trade union also has a direct interest in the level of social benefits. We assume a competitive output market, in which the price level adjusts to changes in demand and supply. In the Nash equilibrium of the model, the output level is always between the target output levels of the trade union and of the government. Although both policy makers are inflation averse, inflation in the Nash equilibrium is positive.

We then investigated how changes of the trade union's degree of inflation aversion affect the Nash equilibrium. An increase in the union's inflation aversion will always increase output and decrease the equilibrium price and wage levels, whatever the degree of inflation aversion of the government. The effect on the level of social benefits is more ambiguous. It depends on whether social benefits and wages are strategic complements or substitutes for the government. This, in turn, depends on the degree of inflation aversion of the government. An increase of the union's degree of inflation aversion leads to an increase of social transfers in economies in which the government is not very inflation averse, and to a decrease of social transfers in economies in which the government is strongly inflation averse. It would be interesting to try to test all these implications empirically.

In their stabilization policy game between the government and the trade union Di Bartolomeo et al (2004) conclude that there is no scope for corporatism, since the trade union will not benefit from cooperation. However, this result

is based on the underlying strong assumption that the trade union only cares about employment and wages. In particular, they assume that the trade union is inflation neutral. Moreover, there is no social policy in their model. A model that includes a positive degree of inflation aversion of the trade union would lead to a different conclusion. Starting in the Nash equilibrium, a trade union that is inflation averse will be willing to deliver wage restraint in order to decrease inflation. Even if the degree of inflation aversion of the trade union is zero, the scope for corporatism remains in a model that considers social policy goals of the trade union. The threat of the government to keep the level of social benefits as low as to the social benefit level in the Nash equilibrium if the trade union sticks to its high demand of wages, will make the union willing to negotiate. An increase of the social transfers will always benefit the trade union. We can conclude, therefore, that there always exists a cooperative agreement of lower wages in exchange for higher social benefits that is beneficial for both the government and the trade union.

Appendix A Price and Output Effects

In order to calculate the derivatives $\phi_w(w, b)$ and $\phi_b(w, b)$, we first simplify the notation. From (7) it is clear that the aggregate excess demand on the output market depends on p through three different channels: (1) there is a direct price effect of a change in p , keeping $\frac{w}{p}$ and $\frac{b}{p}$ constant, (2) there is a real wage effect, as a change in p affects the real wage $\frac{w}{p}$, and (3), finally, there is real benefit effect, as a change in p also affects the real benefit $\frac{b}{p}$. Let us therefore rewrite the excess demand function on the output market on the LHS of (7) as

$$X(p, \frac{w}{p}, \frac{b}{p}) = 0$$

By the definition of the function ϕ we must have

$$X \left[\phi(w, b), \frac{w}{\phi(w, b)}, \frac{b}{\phi(w, b)} \right] = 0 \quad (36)$$

One easily derives that

$$\phi_w(w, b) = \frac{-X_2/p}{X_1 - X_2(w/p^2) - X_3(b/p^2)} \quad (37)$$

where X_1 , X_2 , and X_3 are the partial derivatives of $X(p, \frac{w}{p}, \frac{b}{p})$ with respect to p , $\frac{w}{p}$, and $\frac{b}{p}$. In order to determine the sign of $\phi_w(w, b)$, we first analyze the signs of X_1 , X_2 , and X_3 .

Using the traditional arguments (also briefly stated in the text) it is clear that the direct price effect is negative, i.e. $X_1 = C_1 < 0$. One also easily derives that

$$X_2 = [C_2(1 - t) + t] g\left(\frac{w}{p}\right) (1 - |\eta|) + (1 - C_2) g'\left(\frac{w}{p}\right) \frac{b}{p} - q'\left(\frac{w}{p}\right) \quad (38)$$

X_2 gives the effect of an increase in the real wage level on aggregate excess demand. The symbol η denotes the price elasticity of the demand for labor. We will assume that $|\eta| < 1$. The first term on the RHS of (38) is then positive. Moreover, as $q(\frac{w}{p}) = f(g(\frac{w}{p}))$, it follows that $q'(\frac{w}{p}) = f'(n^d) g'(\frac{w}{p}) = \frac{w}{p} g'(\frac{w}{p})$ so that the second and the third terms on the RHS of (38) are given by

$$(1 - C_2) g'(\frac{w}{p}) \frac{b}{p} - q'(\frac{w}{p}) = \left[(1 - C_2) \frac{b}{p} - \frac{w}{p} \right] g'(\frac{w}{p})$$

As it is reasonable to assume that $b < w$, this expression is positive. We conclude therefore that X_2 is positive, provided $|\eta| < 1$, and $b < w$. Finally, X_3 is given by

$$X_3 = -(1 - C_2)(\bar{n} - g(\frac{w}{p})) \quad (39)$$

which is negative. It represents the effect of an increase in the real benefit $\frac{b}{p}$ on aggregate excess demand. Given the government's budget constraint (3), an increase in the real benefits leads to a decrease in government demand G . As the marginal propensity to consume C_2 is assumed smaller than 1, this must decrease aggregate excess demand.

If we now assume that the direct price effect dominates the real benefit effect, in the sense that

$$X_1 - X_3(b/p^2) < 0 \quad (40)$$

it follows from (37) that $\phi_w(w, b) > 0$. Moreover, from (37) it also follows that $\frac{w}{p}\phi_w(w, b) < 1$. This means that the elasticity of the equilibrium price level with respect to the nominal wage level is smaller than 1.

From (36) we also easily derive that

$$\phi_b(w, b) = \frac{X_3(1/p)}{X_1 - X_2(w/p^2) - X_3(b/p^2)} \quad (41)$$

Making the same sign assumptions as before, we conclude that $\phi_b(w, b) < 0$. Given the government's budget constraint (3), an increase of b leads to a net decrease in aggregate demand, so that the equilibrium price will decrease.

Appendix B Comparison of the slopes of $QBRL^G$ and $A^T(b)$

From $p = \phi(w, b)$ and $y = q(\frac{w}{\phi(w, b)})$ one easily derives that

$$\begin{cases} dp = \phi_w(\cdot)dw + \phi_b(\cdot)db \\ dy = q'(\cdot)(\frac{p-w\phi_w(\cdot)}{p^2})dw - \frac{w}{p^2}q'(\cdot)\phi_b db \end{cases} \quad (42)$$

From $b = b(w)$ it also follows that

$$db = b'(w)dw \quad (43)$$

Combining (42) and (43) yields the slope of $QBRL^G$

$$\frac{dp}{dy} = \frac{1}{\frac{w}{p^2} q'(\frac{w}{\phi(w,b)}) \left[\frac{\frac{p}{w}}{\phi_w(w,b) + \phi_b(w,b)b'(w)} - 1 \right]} \quad (44)$$

The slope of $A^T(b)$ is given in (19). The inequalities $|Slope\ QBRL^G| \lesseqgtr |Slope\ A^T(b)|$ are then equivalent to

$$\left| \frac{1}{\frac{w}{p^2} q'(\frac{w}{\phi(w,b)}) \left[\frac{\frac{p}{w}}{\phi_w(w,b) + \phi_b(w,b)b'(w)} - 1 \right]} \right| \lesseqgtr \frac{\phi_w(w,b)}{q'(\frac{w}{\phi(w,b)}) \left(\frac{p-w\phi_w(w,b)}{p^2} \right)}$$

Simplifying these inequalities shows that they are equivalent to

$$1 \lesseqgtr \frac{\phi_w(w,b)}{\phi_w(w,b) + \phi_b(w,b)b'(w)} \quad (45)$$

which is again equivalent to $b'(w) \gtrless 0$.

Appendix C Comparison of the slopes of $QBRL^T$ and $A^G(w)$

From $w = w(b)$ we derive that

$$dw = w'(b)db \quad (46)$$

Combining (42) and (46) we obtain the slope of $QBRL^T$

$$\frac{dp}{dy} = \frac{1}{\frac{w}{p^2} q'(\frac{w}{\phi(w,b)}) \left[\frac{\frac{p}{w} w'(b)}{\phi_w(w,b)w'(b) + \phi_b(w,b)} - 1 \right]} \quad (47)$$

The slope of $A^G(w)$ is given in equation (13). The inequalities $Slope\ QBRL^T \lesseqgtr Slope\ A^G(w)$ are equivalent to

$$\left| \frac{1}{\frac{w}{p^2} q'(\frac{w}{\phi(w,b)}) \left[\frac{\frac{p}{w} w'(b)}{\phi_w(w,b)w'(b) + \phi_b(w,b)} - 1 \right]} \right| \lesseqgtr -\frac{1}{q'(\frac{w}{\phi(w,b)}) \frac{w}{p^2}}$$

Simplifying these inequalities shows that they are equivalent to

$$1 \lesseqgtr \frac{1}{\left[\frac{\frac{p}{w} w'(b)}{\phi_w(w,b)w'(b) + \phi_b(w,b)} - 1 \right]} \quad (48)$$

which is again equivalent to $w'(b) \gtrless 0$

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