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The inflation target and the structure of labour markets: Implications for common monetary policy

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7/99

Juha Kilponen

Research Department
14.6.1999

The Inflation Target and the Structure of Labour Markets: Implications for Common Monetary Policy

SUOMEN PANKIN KESKUSTELUALOITTEITA • FINLANDS BANKS DISKUSSIONUNDERLAG

Juha Kilponen*

Research Department
14.6.1999

The Inflation Target and the Structure of Labour Markets: Implications for Common Monetary Policy

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The Inflation Target and the Structure of Labour Markets: Implications for Common Monetary Policy

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Abstract

Both the optimal inflation target and the optimal degree of output stabilization are found to be conditional on the prevailing wage bargaining structure. If monopolistic wage setters act as strategic leaders of the monetary policy game, an explicit inflation targeting regime removes inflation bias from monetary policy, but does not remove the trade-off related to average level of output and output stabilization. In contrast to usual results on inflation targeting, appointing a central banker who is more conservative than the government leads to welfare gains for society. If centralization within the national labor markets increases in the common monetary policy area, the monetary policy game with regard to the European Central Bank might be conducted under the strategic leadership of trade union confederations. This leads to a Pareto loss.

Keywords: monetary policy, labor markets, European Monetary Union, inflation targeting

Inflaatiotavoite ja työmarkkinoiden rakenne: näkökulma yhteiseen rahapolitiikkaan

Suomen Pankin keskustelualoitteita 7/99

Juha Kilponen
Tutkimusosasto

Tiivistelmä

Sekä optimaalinen inflaatiotavoite että rahapolitiikan optimaalinen akkommodaatio riippuvat palkanasetantajärjestelmän rakenteesta. Inflaatiotavoitteen avulla rahapolitiikasta voidaan poistaa inflaatioharha, mutta jos keskusjärjestöt toimivat inflaatiopelin johtajina, yhteiskunta joutuu myös inflaatiotavoitetta käytettäessä etsimään optimaalisen tasapainon tuotannon vaihtelun ja tuotannon keskimääräisen tason välillä. Tästä seuraa, että konservatiivinen keskuspankki lisää yhteiskunnan hyvinvointia. Jos keskittyminen maiden sisäisillä työmarkkinoilla yhteisen rahapolitiikan oloissa kasvaa, voi seurauksena olla peli, jossa keskusjärjestöt toimivat ns. Stackelberg-johtajina Euroopan keskuspankkiin nähden eli ottavat huomioon Euroopan keskuspankin mahdollisen akkommodoivan reaktion palkkatavoitteissaan. Tämä johtaa kaikkien osapuolten kannalta epätyydyttävään tulokseen.

Asiasanat: rahapolitiikka, työmarkkinat, talous- ja rahaliitto, inflaatiotavoite

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1 Introduction

There are basically two extreme directions towards which collective bargaining practises may develop in Europe and in the EMU. First, increasing centralisation of the national wage bargaining enable large confederations to act as leaders or monopolies at the national level. National confederations, then, take into consideration a labor market development in different European countries. In second scenario, wage bargaining remains uncentralised and industry unions negotiate wages nationally or, due to a closer product market and labor market integration, national industrial unions react to wage demands in corresponding industries of the other countries.

The strategic interaction between monetary authorities and wage setters in these different scenarios is obviously different. In brief, if confederations become concerned on labor markets accross countries, each national confederation can be thought of as individual player that behaves strategically against the other unions and the European Central Bank (ECB). If wage bargaining remains uncentralised in the common monetary policy area, then the wage setting game is still primarily played within the countries or accross different industries and the European wide aggregates will be ignored by the unions.

This paper provides an analytically tractable framework to analyse interaction between different monetary policy strategies and wage bargaining. As a starting point, we use a basic Barro-Gordon (1983) type of credibility model, but with two fundamental differences from the traditional setup. First, we replace the representative, expectational errors minimising agent with monopolistic wage setters, who are large enough to have a significant influence on the aggregate behaviour of the economy. Second, we assume that these large enough wage setters can have a strategic advantage over monetary policymakers. That is, they may behave as Stackelberg leaders of the game. With these two modifications, a resulting equilibrium is conditional on institutional settings of wage bargaining, the monetary policy strategy and the assumed strategic interaction of the players.

The model is, therefore, designed to address interaction between wage formation and monetary policy in the countries were the role of unions in wage formation is substantial. Indeed, although unionisation and collective bargaining has been in decline in many countries recently, unions still play an important role in Europe. For instance, in the Netherlands union membership fell from 35% to 26% of eligible workers between 1980 and 1994, yet the share of workers covered by the terms of union contracts rose to 81% in 1994. Only in New Zealand, the United States, Australia and Britain have the coverage of collective bargaining and unionisation rates both fallen considerably. Only United States, Japan and Canada had both unionisation and coverage rates below 40% in 1994 (OECD(1997)). Subsequently, the model will be used to discuss implications of the above mentioned scenarios on optimal design of monetary policy strategy.

With regard to monetary policy strategies, we concentrate on explicit inflation

targeting. While many countries[1] adopted explicit inflation targeting in 1990s, the European Central Bank seems to have chosen a monaetary policy strategy, which is somewhere between inflation targeting and monetary targeting[2]. However, an analytic model discussed in this paper does not make a difference between explicit inflation or money supply target, because we assume that inflation is perfectly and directly controlled by the monetary authority.

In conventional (static) model of explicit inflation targeting (Svensson (1997)), an explicit inflation target provides an "anchor" for rational expectations and removes an inflation bias without policymakers' needing to compromise with flexibility of the policy. This is an advantage with regard to Rogoff´s (1995) suggestion of appointing weight conservative central banker. From the society´s point of view, the Rogoff´s weight conservative central banker finds a best balance between inflation bias and output variation. The end result is partial offset of supply shocks and lower inflation.

We show, however, that the results from the conventional inflation targeting model is not robust to different assumptions about private sector´s behavior. When the wage setting unions are large enough and act as strategic leaders of the game, an explicit inflation targeting regime removes inflation bias, but generates a trade-off between average output performance and volatility. The more conservative central banker (less accommodative) brings better average output performance, but at the same time increases output volatility.

Effects of transition from national monetary policy to common monetary policy depends crucially upon the new institutional setting of wage formation. If national confederations, indeed, find themselves strong enough to take a strategic leadership with respect to the European Central Bank and are concerned on labor market development in the other countries, the monetary policy game is best described by the wage setters leadership game. This proves to be a worst situation for all the participants.

If the wage setting remains decentralised, the monetary policy game is, then, best described as de facto Nash game among all the participants. In this regime, industry wide unions take the monetatary policy of the European Central Bank as unaffected by their individual decisions. This proves desirable for all the players. Moreover, in this regime, an explicit inflation targeting regime successfully removes inflation bias without a need to compromise with a flexibility of the monetary policy. If the labor markets change such that accross country labor

[1]Explicit inflation targeting regime was first adopted in New Zealand in 1990, under the Policy Targets Agreement. This was followed in 1989 by the Reserve Bank of New Zealand Act, which established a statutory commitment to price stability. Canada followed in February 1991 by introducing inflation-reduction targets, in a joint declaration by the Bank of Canada and the Canadian government. The United Kingdom turned to inflation targeting in October 1992 after the collapse of ERM exchange rate band in September 1992. Similarly, the Riksbank of Sweden announced explicit inflation targets in January 1993 following the dramatic breakdown of the currency peg in November 1992. Finland followed shortly after in February 1993, again after the breakdown of the currency target zone in September 1992. Australia introduced an inflation target in April 1993, Mexico in September 1994 and Spain in summer 1994.

[2]For the choice between monetary targeting and inflation targeting see Svensson (1999)

markets within particular industries become important, implications of national centralisation of wage bargaining can be extended to European wide context.

The rest of the paper is organized as follows. In section 2 we describe the basic setup of the model for individual countries. Section 3 analyses the conventional cases of precommitment and discretion. Section 4 analyses a case where the wage setters act as Stackelberg leaders of the game. Section 5 analyses an explicit inflation targeting regime under the wage setters leadership. Section 6 discusses implications of the derived results for the EMU and explains how the model can be reinterpreted in the context of common monetary policy. Same section also modifies the model such that a common monetary policy reacts to shocks common to all countries. Finally, section 7 concludes and section 8 relates our model to recent literature.

2 The model

The model we develop extends and modifies Barro and Gordon (1983) and Svensson (1997). The main difference is due to the fact that we model the private sector as composed of monopolistic unions who set the nominal wage. In the conventional approaches, the private sector forms rational expectations and minimizes expectational errors. In our model a familiar time inconsistency problem arises endogenously from monopolistic wage competition. Monopolistic competition in wage setting generates too high real wage, which in turn lowers output below the natural rate in equilibrium. This creates a familiar time inconsistency problem, when the policymakers have incentives to stabilise output.

The firms' behavior is characterized by the following aggregate supply equation

$$y_t = \overline{y} + p_t - w_t + \epsilon_t \tag{1}$$

y_t is log of the output at time t, $\overline{y}$ is log of the natural rate of output, p_t is log of the price level, $w_t = \frac{1}{N}\sum_{i=1}^{N} w_{it}$ is average wage level and ϵ_t is aggregate supply shock with $E(\epsilon_t) = 0$ and $E(\epsilon_t^2) = \nu^2$. There are N monopolistic unions (wage setters) in the economy and each one has the following utility function (u_{it})[3]

$$u_{it} = l_{it} + (w_{it} - p_t^e) l_{it} \tag{2}$$

where

$$l_{it} = \frac{y_t}{N} - \gamma_i (w_{it} - w_t) \tag{3}$$

$$w_t = \frac{1}{N}\sum_{i=1}^{N} w_{it} \tag{4}$$

These wage setters can be understood as utility maximizing unions who provide labour for the competitive industry, facing the labour demand function (3).

[3]Form of the utility function is similar to Akhand (1992).

Implicitly, we assume that each union is large enough to have effect on aggregate wages. Each wage setter is best understood as industry specific union, where each industry produces perfectly substitutable commodity, but labor between different industries is not perfectly substitutable. We discuss in section 7 how the model and the labor markets can be interpreted in the European wide context, but so far, the model is best interpreted in the national context with national monetary policy.

Unions care about log of labor share (l_{it}) and log of real wage bill $(w_{it} - p_t)l_{it}$. The labor share of the each union depends upon aggregate labor demand, which in turn depends linearly on aggregate supply under an assumption of constant returns to scale, as well as the relative wage $(w_{it} - w_t)$; $\gamma_i > 0$ reflects the monopoly power of each union. This parameter captures different features of imperfect substitutatability of labor. If the model is interpreted in the European wide context and i would refer to countries (or sectors), the parameter γ could embody also the firms re-location capacity. Larger the γ, more easily the firms could react to wage differences by relocating themselves from high wage countries(sectors) into those with lower wages, thus lowering the wage demand in the countries (sectors) with higher wages.

Nevertheless, we restrict $\gamma_i < \frac{1}{N}$. This has an implication that each union has some monopoly power. Clearly, when $N \to \frac{1}{\gamma_i}$, monopoly power of the union decreases. Postulation of the utility function is of course specific, but it provides an intuitive and analytically tractable way to be explicit about wage bargaining structure in the model.

Unions set the wage for period t before the output shock occurs and they have rational expectations. Each union solves

$$\max_{w_{it}} E_0 \left(\sum_{t=1}^{\infty} \rho^{t-1} u_{it} \right) \tag{5}$$

subject to relevant constraints.

We assume that each union holds the same rational expectations about the price level and the wage set by the other unions. That is

$$p_{it}^e = E_{t-1}^i p_t = E_{t-1} p_t = p_t^e \tag{6}$$

$$E^i w_j = w_j, \forall i \neq j \tag{7}$$

p_{it}^e denotes expectation of the price level of the union i. E_{t-1} denotes expectation conditional upon information available in period $t-1$, which includes the realization of all variables up to and including period $t-1$, as well as constant parameters of the model. E^i denotes expectations of the union i. We assume away all the information asymmetries and all the unions are similar. The log of the long-run natural level of output will be set for convenience and without loss of generality equal to 1.

The government is assumed to minimize

$$V_t = E_0 \left[\sum_{t=1}^{\infty} \beta^{t-1} L_t \right] \tag{8}$$

where

$$L_t = \frac{1}{2}\left[(\pi_t - \pi^*)^2 + \lambda(y_t - y^*)^2\right]$$

$\pi_t = p_t - p_{t-1}$ is inflation at time t and π^* and y^* are the target levels of inflation and output respectively. $\lambda \geq 0$ is the weight that the government assigns to output stabilization.

An inflation targeting regime is interpreted as a delegation of monetary policy to the central bank with an assigned loss function

$$L_t^{cb} = \frac{1}{2}\left[\left(\pi_t - \pi^{cb}\right)^2 + \lambda(y_t - y^{cb})\right] \tag{9}$$

The targets π^{cb} and y^{cb} may differ from the corresponding parameters in a general loss function (V_t), while λ is the same in both loss functions. This assumption will be relaxed later on, however. Contrary to the Svensson (1997), we assume that the government targets natural rate i.e. $y^* = 1$. Therefore, we do not need to make an ad hoc assumption as to why the government's targeted output is above the actual natural rate. Although the output target of the central bank may differ from the target of the government, our main results are derived under the assumption that $y^{cb} = y^* = 1$. This assumption is by no means essential for derived results.

The central bank is assumed to have perfect control over inflation rate π_t. It sets the inflation rate each period after having observed the current supply shock ϵ_t. This assumption that the central bank has a perfect control over inflation is perhaps unrealistic but convenient. The introduction of an instrument, such as money supply, by which inflation were controlled would allow us to consider the effects of a demand (or velocity) shock to the economy. Persson and Tabellini (1997), however, show that demand shocks can be fully offset by policymakers, provided that the policymaker's loss function is as given in (8) and that there are no information asymmetries. Abstracting from the issue of controllability of money supply in the stochastic economy, controlling inflation by the instrument (money supply) or controlling inflation directly is effectively equivalent.

Notice also that we assume that both the unions and the government observe the natural rate $\overline{y}$ before action. The fact that only the policymakers observe the supply shock implies that they have a better knowledge of the state of the economy and that they can react "more flexibly" to these changes when compared with wage-setters. This informational advantage allows policymakers to stabilize the economy.

3 Conventional cases

3.1 Commitment to an optimal rule

First, consider a situation when the central bank is directly controlled by the government, so the government can choose inflation rate in each period, conditionally

upon the observed supply shock. Furthermore, assume that the government can commit to a state contingent rule for inflation rate. Without output persistence or any other intertemporal link, the problem of minimizing the intertemporal loss function is equivalent to the static problem of minimizing the expected one period loss function. In this set up the minimization problem can be formulated as follows

$$\begin{aligned} & \min_{p_t, p_t^e} E_{t-1}\left[L_t\right] \\ & s.t. \\ y_t &= 1 + p_t - w_t + \epsilon_t \\ w_t &= w_t(p_t^e) \\ p_t^e &= E_{t-1} p_t \end{aligned}$$

The government internalizes the effect of its policy on the nominal wage rule $w_t = w_t(p_t^e)$. This is the wage rule that results from the unions' maximization problem.

Following Svensson (1997), under the precommitment to a state contingent rule, the government's Lagrangian ($\mathcal{L}_t$) can be written

$$\mathcal{L}_t = E_{t-1}\left[\frac{1}{2}\left[(\pi_t - \pi^*)^2 + \lambda(p_t - w_t(p_t^e) + \epsilon_t)^2\right] - \theta_{t-1}\left(p_t^e - E_{t-1}p_t\right)\right] \tag{10}$$

where $\pi_t = p_t - p_{t-1}$, and θ_{t-1} is Lagrange multiplier. The first order conditions with respect to p_t and p_t^e respectively are

$$p_t - p_{t-1} - \pi^* + \lambda(y_t - 1) + \theta_{t-1} = 0$$

$$-E_{t-1}\left[\lambda(y_t - 1)\right] w_t^{'}(p_t^e) - \theta_{t-1} = 0$$

where $w_t^{'}(p_t^e) = \frac{\partial w_t}{\partial p_t^e}$. Eliminating the Lagrange multiplier and taking expectations at $t-1$ yields

$$E_{t-1}p_t - p_{t-1} - \pi^* + E_{t-1}\lambda(y_t - 1) - E_{t-1}\lambda(y_t - 1)w_t^{'}(p_t^e) = 0 \tag{11}$$

In order to find $w_t^{'}(p_t^e)$, we need to consider the union's problem. In each period t, union i faces the same optimization problem and because there is no intertemporal link, maximization of (5) is, again, the same as maximizing the one period utility.

The union $i's$ optimization problem is therefore

$$\begin{aligned} & \max_{w_{it}} E_{t-1}^i\left(1 + w_{it} - p_t\right)\left(\frac{y_t}{N} - \gamma_i\left(w_{it} - w_t\right)\right) \qquad (12) \\ & \text{s.t.} \\ y_t &= 1 + p_t - w_t + \epsilon_t \end{aligned}$$

The unions act simultaneously among themselves and they form rational expectations about the government's policies i.e. price level p_t. Solving the first order

conditions and imposing symmetry yields

$$w_t = p_t^e + \sigma_h \tag{13}$$

$$\sigma_h = \frac{(1 - N\gamma)(N-1)}{1 + (\gamma(N-1)+1)N} \tag{14}$$

σ_h stands for *the real wage bias.* It can be shown that $\sigma_h \in (0,1)$, as long as $1 \leq N < \frac{1}{\gamma}$, i.e. as long as each union has some monopoly power in the wage setting. It can easily be shown also that this real wage bias (σ_h) is hump-shaped, reaching a maximum at $N = \sqrt{\frac{1}{\gamma}}$.

If we interpreted the number of unions (N) in the wage setting process as a proxy for the degree of centralisation in wage bargaining, it can be noticed that, at given γ, this bias is hump-shaped as suggested in Calmfors and Driffill (1988). The wage bargaining systems that are somewhere between the centralised and decentralised systems are characterised as having the highest real wage bias.

The parameter γ embodies the degree to which wage setters are affected by the wage decisions of the others. When making a comparison between countries and the relationship between the degree of centralisation and real wages it is important to notice that a varying degree of competitiveness (γ) in different countries distorts this hump-shaped relationship. At sufficiently low level of competition $\left(\gamma < \frac{1}{N^2}\right)$ decrease in the number of unions(centralisation) can lead into a higher real wage wage.

From the point of view of institutional desing of the labor markets, this result emphasises the fact that labor market performance can be improved, not only by chancing the degree of centralisation appropriately, but also by increasing the substitutability of labor. When the model is interpreted in the European wide context so that the industry unions would bear in mind corresponding industries in another countries, parameter γ could embody the firms re-location potential. Consequently, removing the barriers from firm´s ability to move their production sites accross countries would make γ larger. Then, labor demand elasticity would be increased and the real wage bias would become smaller.[4]In more general, if the deepening product and labor market integration, indeed, leads industrial unions to respond to wage demands in another countries, implications of national centralisation of wage bargaining can be extended into European wide context.

Substituting (11) into the wage rule and solving for rational expectations equilibrium yields

$$w_t^c = p_{t-1} + \pi^* + \sigma_h \tag{15}$$

Combining then (1), (11) and (13) we obtain the optimal decision rule of the government

$$\pi_t^c = \pi^* - \frac{\lambda}{1+\lambda}\epsilon_t \tag{16}$$

[4]It can easily be shown that $\frac{\partial \sigma_h}{\partial \gamma} < 0, \forall\ N > 1$.

The superscript c stands for commitment. Given the optimal inflation rule (16) and the wage rule (15), output will satisfy

$$y_t^c = 1 - \sigma_h + \frac{1}{1+\lambda}\epsilon_t \tag{17}$$

Contrary to the usual results, even in the commitment case *average output is below the desired rate of unity, by an amount that depends upon the size of the distortion in the labor markets* (σ_h). Without distortions in the labor markets, i.e. when $\sigma_h = 0$, average output will be at its target level.

Regardless of the fact that output still deviates from the target, this situation is clearly the first best for the government at the given labor market structure. Notice that neither an expected deviation of output from the target or wage does depend upon accommodation parameter λ. This result already emphasizes that "too low output" can be due to structural problems in the labor markets only, where monetary policy strategy cannot influence.

As usual, precommitment to an optimal state contingent rule is time-inconsistent. This can be easily seen by noticing that an ex ante precommitment policy is sub-optimal ex post. Evaluating an expected marginal gain of "surprise inflation" at given w_t^c, π_t^c we find that

$$\frac{\partial E_{t-1} L(\pi, y)}{\partial \pi} = -\lambda\sigma_h \leq 0 \tag{18}$$

When $\sigma_h > 0$ and $\lambda > 0$ expansion (surprise inflation) reduces the loss of the government. This is the typical result. Moreover, notice that the degree of *"temptation"* to cheat the private sector is larger the larger the distortions in the labor markets and larger the government´s desire to accommodate.

Expected utility of the each union, in turn, will be

$$E\left[u_{it}^c\right] = \frac{1}{1-\rho}\frac{1}{N}\left(1 - \sigma_h^2 + \frac{\lambda}{(1+\lambda)^2}\nu^2\right) \tag{19}$$

Ex post utility of the unions depends upon the accommodation parameter λ, the structure of the labor markets and the variance of output shock. The expected loss of the government in turn is

$$E\left[V_t^c\right] = \frac{1}{1-\beta}\frac{1}{2}\left(\lambda\sigma_h^2 + \frac{\lambda}{1+\lambda}\nu^2\right) \tag{20}$$

3.2 Discretion

Assume now that the government still retains control of the central bank, but that it cannot commit to a state contingent rule, due to the time-inconsistency problem. The government chooses π_t in each period t so as to minimize the one period loss function L_t subject to the supply equation, disregarding the wage setting behavior of the unions. In other words, the government sets its policy after wages and expectations have been formed. Unions behave as before.

The first order condition for the government (central bank) is then simply

$$\pi_t - \pi^* + \lambda(p_t - w_t - \epsilon_t) = 0 \tag{21}$$

Unions behave as above, so that

$$w_t = p_t^e + \sigma_h \tag{22}$$

Solution for rational expectations equilibrium yields the following optimal wage and inflation rules

$$w_t^d = p_{t-1} + \pi^* + (1+\lambda)\sigma_h \tag{23}$$

$$\pi_t^d = \pi^* + \lambda\sigma_h - \frac{\lambda}{1+\lambda}\epsilon_t \tag{24}$$

Given the optimal decision rules (23) and (24) output will be determined by

$$y_t^d = 1 - \sigma_h + \frac{1}{\lambda+1}\epsilon_t \tag{25}$$

Output will behave similarly under discretion and under commitment. This is because real wages will be the same in the discretionary and in the commitment regimes. However, expected inflation is higher in the discretionary regime by an amount that depends upon magnitude of the distortion in the labor markets and the weight that the government attaches to the target level of output. More precisely,

$$\pi_t^d - \pi_t^c = \lambda\sigma_h$$

This is a typical result, where higher inflation does not yield any output gain. Notice, however, that as in the commitment case, the average level of output does not depend upon the degree of accommodation (λ), while high inflation is related both an incentive problem of the policymakers (positive λ) as well as wage bargaining structure.

The policy response to the supply shock ϵ_t is similar under discretion and under precommitment. This equivalence is specific to the static setup of the model and as shown by Svensson (1997) and discussed by Persson and Tabellini (1997) does not carry over to a dynamic model where output is serially correlated. In the dynamic model, the future inflation bias depends upon current output. This leads to the situation where the policymaker responds more aggressively to supply shocks under discretion than under precommitment.

While the government is worse off under discretion, wage setters are indifferent between discretionary and commitment regimes. The unions are indifferent because they do not care about the level of inflation, but only about the real wage and output. The government, on the other hand, is worse off because it also cares about inflation, which is higher in the discretionary regime when compared with the precommitment regime. Formally, the government's expected loss under discretion is

$$E\left[V_t^d\right] = \frac{1}{1-\beta}\frac{1}{2}\left(\lambda\sigma_h^2(1+\lambda) + \frac{\lambda}{1+\lambda}\nu^2\right) > E\left[V_t^c\right] \tag{26}$$

while the expected utility of the unions under discretion is

$$E\left(u_{it}^{d}\right)=\frac{1}{1-\rho}\frac{1}{N}\left(1-\sigma_{h}^{2}+\frac{\lambda}{(1+\lambda)^{2}}\nu^{2}\right)=E\left(u_{it}^{c}\right) \tag{27}$$

4 Wage setters' leadership

Most of the models of the kind assume that the private sector treats the control variables of the policymakers (policy variables) as given. As clarified by Marcellino and Salmon (1997), taking the policy variables as given in effect assumes that the private sector cannot or does not need to learn *the form of the implicit policy rule.* Then, as noted also by Cubitt (1992), the private sector does not play a strategic game with the policymaker at all. One way of giving the private sector a strategic role, as it will be done here, is to assume that the private sector respond to the actual policy rule of the policymakers, due to the strategic advantage. That is, wage setters become strategic leaders of the game.

In unionized economies, an existence of binding wage contracts imply that the policymakers may no longer have the dominant role because the wage setters have precommited themselves to a negotiated wage conditional on the policymakers' announcement regarding future policy. In the unionized economies, where at least partially centralized wage setting play a role, nominal wages are typically fixed by at least a one-year wage contract. Therefore, motivation for the Stackelberg leadership of the unions in our model, comes form the sequence of decisions taken by the wage setters and policymakers. Wage contracts are also usually legally binding for the whole contact period and cannot be renegotiated.

Driffill (1985) has emphasized that the governments of industrial countries have used monetary and fiscal stabilization triggered by the actual unemployment level, with no reference to the real wage, with the aim of achieving target unemployment. Also, while the unemployment rate can be continuously and accurately monitored, real wages are more difficult to measure. This could be interpreted as a sign that monetary policymakers take wages as given when forming their policies, that is, act as followers. [5]

In our setup, when deciding upon wages, each union anticipates that higher wage leads lower employment share and higher inflation. The trade-off between higher wage, employment and desire of monetary authority to accommodate too high wage makes each wage setter to choose a wage that makes a balance between these different trade-offs. Resulting equilibrium wage is therefore conditional on both wage bargaining structure and desire of policymakers to accommodate.

[5] Gylfason and Lindbeck (1986) argue that it is somewhat hazardous to apply simple scheme of alternative strategies to a real world situation. Labor market institutions in different countries differ to great extent and therefore, the leadership of the unions may not be plausible in some countries (Japan, Switzerland, and Austria), while in a other countries, notably in Sweden and Finland, the leadership of the unions could be easily accepted. In some countries (e.g. the U.K), the 'warfare' between the unions and the government would probably illustrate the situation best.

Formally, the maximization problem of the unions can be written

$$\begin{aligned}
& \max_{w_{it}} E_{t-1}^{i}\left(1+w_{it}-p_t\right)\left(\frac{y_t}{N}-\gamma_i\left(w_{it}-\frac{1}{N}\sum_{i=1}^{N}w_{it}\right)\right) \\
& s.t. \\
y_t &= 1+p_t-w_t+\epsilon_t \\
E_{t-1}p_t &= p_t^e=\frac{1}{1+\lambda}\left[p_{t-1}+\pi^*+\lambda E_{t-1}w_t\right]
\end{aligned}$$

The second constraint is the expected value of the government's first order condition under discretion. The difference from the precommitment case of the government analyzed before is that each union responds to the expected optimal state contingent rule of the government, that depends upon the economy-wide wage level ($w_t=\left(\frac{1}{N}\sum_{i=1}^{N}w_{it}\right)$). Due to this feedback effect, unions are able to "exploit" the government's desire to accommodate when $\lambda>0$.

Solving the maximization problem, imposing symmetry and solving for rational expectations equilibrium yields the linear optimal wage rule

$$w_t^{pc} = p_{t-1}+\pi^*+(1+\lambda)\,\sigma_{pc} \tag{28}$$

$$\sigma_{pc} = \frac{(N-1)\,(1-\gamma N)}{\left(\frac{1-\lambda}{1+\lambda}+N\left(\gamma(N-1)+1\right)\right)} \tag{29}$$

Superscript pc stands for the private sector's (wage setters') commitment. The term σ_{pc} represents real wage bias. σ_{pc} includes the parameter λ, and differs from σ_h in (14) only by the term $\frac{1-\lambda}{1+\lambda}$ which replaces 1 in the denominator of σ_h. Since $\left|\frac{1-\lambda}{1+\lambda}\right|\leq 1$, it is clear that $\sigma_{pc}\geq\sigma_h\geq 0$.

Moreover, it is easy to show that $\frac{\partial\sigma_{pc}}{\partial\lambda}\geq 0$. This implies that the more the government is concerned with output stabilization the higher will be the real wage bias. Notice that if the central bank was not concerned on employment stabilization ($\lambda=0$) optimal wage rule would become same as in the discretionary case.

Turning back to the government's problem, the government acts now under discretion, solving a problem

$$\begin{aligned}
& \min_{p_t} E_{t-1}\left[L_t\right] \\
& s.t. \\
y_t &= 1+p_t-w_t+\epsilon_t
\end{aligned}$$

The first order condition is

$$\pi_t-\pi^*+\lambda(y-1)=0 \tag{30}$$

Substituting the optimal wage rule (28) yields

$$\pi_t^{pc}=\pi^*+\lambda\sigma_{pc}-\frac{\lambda}{1+\lambda}\epsilon_t \tag{31}$$

Using the optimal decisions rule (28) and (31) we finally find that output is determined by

$$y_t^{pc} = 1 - \sigma_{pc} + \frac{1}{1+\lambda}\epsilon_t \tag{32}$$

The expected loss of the government will be

$$E\left(V_t^{pc}\right) = \frac{1}{1-\beta}\frac{1}{2}\left((\lambda+1)\lambda\sigma_{pc}^2 + \frac{\lambda}{1+\lambda}\nu^2\right) \tag{33}$$

Therefore, it is clear that

$$E\left(V_t^{pc}\right) > E\left(V_t^d\right) > E\left(V_t^c\right),\ \forall\ \lambda > 0,\ 1 < N < \frac{1}{\gamma} \tag{34}$$

The expected utility of the each individual union will be

$$E\left(u_{it}^{pc}\right) = \frac{1}{1-\rho}\frac{1}{N}\left(1 - \sigma_{pc}^2 + \frac{\lambda}{(1+\lambda)^2}\nu^2\right) < E(u_{it}^c) \tag{35}$$

Both the government and the unions are worse off when compared with precommitment of the government and discretion. However, the typical time inconsistency result in the discretionary regime is now reversed, because *the unions precommitment is time-inconsistent*[6]. This can be seen by evaluating the expected marginal gain of utility of the unions at a given ϵ_t and given π_t^{pc}at equilibrium point w_t^{pc}. It can be easily shown that

$$\frac{\partial E_t(u_{it})}{\partial w_{t|\pi_t=\pi^{pc}|w_t=w^{pc}}} < 0\ \forall\ \lambda > 0,\ 1 < N < \frac{1}{\gamma} \tag{36}$$

The implication of (36) is that if unions could renege on wage contracts, *they would set wages lower.* Therefore, an uncoordinated precommitment of the unions reinforces the desire of each individual union to set its own wage above its rivals. This is due to the government's incentive to stabilize output so that it becomes less costly for each union to set the wage above the market clearing level.

It is of course somewhat paradoxical that legal institutions have developed such that wages are legally binding for the whole contract year and cannot be renegotiated. In this context, these legal institutions provide possibility for the existence of inefficient equilibrium, although they purpose, initially, have been to improve individual workers well being.

This may rationalise the societies incentive to look for coordinated solutions by establishing institutions that enable explicit coordination in wage setting or agree upon institutions were confederations have coercive authority over the unions in wage setting. As can be seen from (35) and (33), prevalence of such wage bargaining institutions become more desirable, more the government is expected

[6] I am indebted to Jouko Vilmunen for noticing that the precommitment of the unions can be time-inconsistent.

to accommodate. Such institutions, in fact, are observed in reality and seem to exist contemporaneously with "accommodative" governments.

One may, now, be triggered to conclude that institutional cooperation solves the problem. However, it is important to notice that difficulty with institutional centralisation and coordination of wage bargaining, combined with a degree of local bargaining power is information asymmetry. In practice, central bargainers rarely have the same information as do local bargainers and thus they cannot be certain whether any wage or price change that deviates from the central agreement does so because of local market conditions unknown to the center or because local bargainers *defect* from the agreement. If the center does not have any instruments to observe and penalize such defect, incentive for each individual union to deviate from centrally agreed contract is present[7] . Moreover, even if inefficiency associated with monopolistic wage competition was solved by some enforcement mechanism among the wage setters, a conflict between private agents and the monetary policy may still be prevail.

These arguments are relevant also for the desirability of European wide centralisation in wage setting. Without explicit enforcement mechanisms European wide centralisation in wage setting is likely to lead into similar problems as in the national economies. Incentives to defect from central agreements can be even more pronounced due to a relatively loose link in industrial relations between different countries.

Nevertheless, another important implication of the result is that *the monetary policy should not be conditioned on the decision variable of the wage setters, when the wage setters act as Stackelberg leaders.* As already argued, this enforces the coordination failure and makes all the players worse off.

5 Explicit inflation targeting under wage setters leadership

Rogoff's (1985) suggestion of improving the discretionary regime by appointing an inflation-averse central banker stated that by choosing some particular preferences for the central banker, social welfare could be improved with regard to that in the discretionary equilibrium. Rogoff's main point was that an optimally inflation averse policy would find (socially) best balance between the stabilisation of output in response to supply shocks and prices in the context of an inflation bias.[8] The end result is lower inflation and a partial offset of supply shocks.

It has been argued that one advantage of strategic delegation of monetary policy through an explicit inflation target is that the government's target inflation can be achieved without a need to compromise the flexibility of the policy. However, we will show that the latter result does not carry through the model

[7] See for instance Freeman and Gibbons (1995) for detailed analysis of the problem.

[8] This trade-off has been explored also in Canzoneri (1985) and Canzoneri and Henderson (1988)

where the wage setters act as leaders of the game.

Formally, consider assigning explicit inflation and output targets, π^{cb} and y^{cb}, to the central bank. These targets may differ from the government's target and are assumed to be chosen at "the constitutional stage". We assume that once the targets π^{cb} and y^{cb} for the central bank are chosen, society can no longer renege on these targets. This may sound unrealistic since dynamic inconsistency is present also in explicit inflation targeting regime. However, as pointed out by McCallum (1995) it is not clear why the central bank should submit to the pressure of dynamic inconsistency. Despite the absence of any precommitment technology, the central bank may nevertheless achieve better results in terms of its preferences by abstaining from the temptation to exploit each period's inconsistency incentives and instead choose a policy that would be optimal if expected inflation was equal to the target rate.

Nevertheless, the possibility of choosing optimal target for the central bank at the constitutional stage provides an additional instrument for the government to find a best balance between flexibility and output stabilisation.[9]

Let the central bank be assigned the one period loss function

$$L_t^{cb} = \frac{1}{2}\left(\pi_t - \pi^{cb}\right)^2 + \lambda(y_t - y^{cb})^2 \tag{37}$$

λ is the same as in the government's loss function. The central bank's optimization problem is now

$$\begin{aligned} & \min_{p_t} E_{t-1}\left(L_t^{cb}\right) \\ & s.t. \\ y_t &= 1 + p_t - w_t + \epsilon_t \end{aligned}$$

The first order condition for the central bank will be (notice that the central bank acts under discretion)

$$\pi_t - \pi^{cb} + \lambda(y_t - y^{cb}) = 0 \tag{38}$$

Wage setters, in turn, solve

$$\begin{aligned} & \max_{w_{it}} E_{t-1}\left(1 + w_{it} - p_t\right)\left(\frac{y_t}{N} - \gamma_i\left(w_{it} - w_t\right)\right) \\ & s.t. \\ y_t &= 1 + p_t - w_t + \epsilon_t \\ E_{t-1}p_t &= p_t^e = \frac{1}{1+\lambda}(p_{t-1} + \pi^{cb} + \lambda E_{t-1}w_t + (y^{cb} - 1)\lambda) \end{aligned}$$

The constraints now are the supply equation and the expected value of the central bank's optimal inflation rule. Solving the maximization problem and rational

[9] Svensson (1997) shows that the explicit inflation targeting regime mimics the linear inflation contract proposed by Walsh (1995).

expectations equilibrium yields

$$w_t^{Tpc} = p_{t-1} + \pi^{cb} + \lambda\left(y^{cb} - 1\right) + (1+\lambda)\,\sigma_{pc} \tag{39}$$

$$\sigma_{pc} = \frac{(N-1)(1-\gamma N)}{\frac{1-\lambda}{1+\lambda} + N(\gamma N - \gamma + 1)} \tag{40}$$

Turning back to the central bank's problem, the optimal inflation rule must still satisfy

$$\pi_t - \pi^{cb} + \lambda(y_t - y^{cb}) = 0 \tag{41}$$

Substituting y_t and the wage rule (39) and solving for π_t yields the optimal inflation rule

$$\pi_t^{Tpc} = \pi^{cb} + \lambda\left(y^{cb} - 1\right) + \lambda\sigma_{pc} - \frac{\lambda}{1+\lambda}\epsilon_t \tag{42}$$

Choosing the target π^{cb} optimally, so that

$$\pi^{cb} = \pi^* - \lambda\left(y^{cb} - 1\right) - \lambda\sigma_{pc} \tag{43}$$

the target inflation (π^*) can be achieved. However, whatever the targeting rule of the central bank is, output is determined by

$$y_t^{Tpc} = 1 - \sigma_{pc} + \frac{1}{1+\lambda}\epsilon_t \tag{44}$$

In this case, average output is clearly lower than under the commitment of the government, when the central bank has incentives to stabilise output. With regard to pure discretionary regime, the situation is better in the sense that inflation bias has disappeared, but worse in the sense that average output deviates more from the target.

The expected loss of the government, when the target is chosen according to (43), and the government shares the preferences of the central bank will be

$$E\left[V_t^{Tpc}\right] = \frac{1}{1-\beta}\frac{1}{2}\left(\lambda\sigma_{pc}^2 + \frac{\lambda}{1+\lambda}\nu^2\right) \tag{45}$$

The expected loss of the unions' is equivalent to the case of precommitment of the wage setters analyzed previously.

It is important to notice that when the wage setters precommit, *a stability-flexibility trade-off of monetary policy has not disappeared, but is relocated in the explicit inflation targeting regime.* In conventional inflation targeting regime, the inflation-bias flexibility trade-off disappears, because policymakers have an additional instrument to control for inflation bias. Here, although inflation target indeed removes the inflation bias, it does not solve the coordination problem associated with wage setters and monetary policymakers.

This is evident from the fact that the deviation of output from the target also depends upon accommodation parameter λ. Less accommodation would mean

higher average output, but this would come with the costs of less flexibility. Consequently, appointment of, at least moderately, conservative central banker is beneficial even in an explicit inflation targeting regime. It can easily be shown that the degree of "optimal conservativeness" depends upon wage bargaining structure in such a way that the higher are distortions, the higher is the optimal degree of conservativeness. We have proved this important result in appendix.

6 Implications for the EMU

6.1 Centralisation at the national level

The results derived above already have some useful implications for the European Monetary Union (EMU). First, assume that the increase in national centralisation leads into a situation where one single national confederation can be thought of as de facto leader or monopoly of the wage negotiations at the national level. Then, the model can be interpreted in the EMU context without modifications, by arguing that each wage setting union represents the single confederation so that i refers to national confederation and N to number of confederations in the European Monetary Union. Output equation can, then, be interpreted as aggregate European wide output equation such that w_t refers to average European wide wage and and p_t to European wide price level. Finally, supply shock ϵ_t can be interpreted as a common shock to all countries.

Then, the model analysed above can be used to consider desirability of the further centralisation of the wage bargaining inside the countries. The future centralisation of wage bargaining inside the countries might make the confederations strong enough to take a strategic leadership with respect to European Central Bank. Consequently, confederations may end in the wage setting and monetary policy game that is best described by the wage setters leadership game analysed above. As discussed, this is the worst situation for all the participants.

6.2 Decentralised wage setting

In another extreme, when there is no explicit mechanism where wages are negotiated at the European level, the model need to be modified. If the wage setting in individual countries remains decentralised, a common monetary policy implies that individual union´s possibility to exploit monetary authority´s desire to accommodate in this simple setup is lost. This is because the European Central Bank (ECB) condition its policy on European wide aggregates.

To analyse this situation formally, let the European Central Bank (ECB) be assigned the one period loss function.

$$L_t^{ecb} = \frac{1}{2}\left(\pi_t - \pi^{ecb}\right)^2 + \lambda_{ecb}(\overline{y}_t^E - 1)^2$$

where $\overline{y}_t^E$ is European wide average output, defined as

$$\overline{y}_t = 1 + p_t - \overline{w}_t^E + \epsilon_t \tag{46}$$

π^{ecb} is the inflation target set for the ECB, $\overline{w}_t^E$ is European wide average wage, defined as

$$\overline{w}_t^E = \frac{1}{M}\sum_{j=1}^{m} w_{jt}$$

and where m is the number of countries in the EMU and w_{jt} is average wage in each individual country. ϵ_t is exogenous aggregate shock common to all the countries. When averaging over the linear output equations we have assumed that individual shocks at the aggregate level at each point of time are on average zero and that natural rates for each country are the same. Accordingly with inflation targeting regime analysed above, the first order condition of the ECB satisfies

$$\pi_t = \pi^{cb} - \lambda_{ecb}(\overline{y}_t - 1) \tag{47}$$

In this regime, we assume that the ECB condition its policy on European wide average output and thus responds only to aggregate shock ϵ_t. If the unions continue as being interested in only with national economy, as they do without explicit coordination of wage bargaining over the countries, they solve

$$\begin{aligned} & \max_{w_{it}} E_{t-1}\left(1 + w_{ijt} - p_t\right)\left(\frac{y_{jt}}{N} - \gamma_i\left(w_{it} - w_{jt}\right)\right) \\ & s.t. \\ y_{jt} &= 1 + p_t - w_{jt} + \epsilon_{jt} + \epsilon_t \\ E_{t-1}p_t &= \frac{1}{1+\lambda_{ecb}}(p_{t-1} + \pi^{ecb} + \lambda_{ecb}E_{t-1}\overline{w}_t^E) \end{aligned}$$

in each country. ϵ_{jt} is now defined as a country specific shock and y_{jt} refers to individual country´s output. For simplicity, we assume that $E\left(\epsilon_{jt}\epsilon_t\right) = 0$, that is, country specific shocks do not correlate with the aggregate shock. For the time being, we also maintain an assumption that neither ϵ_{jt} or ϵ_t are observed by the unions. Moreover, we assume that each union is too small to take into account its effect on the average European wide wage level. These assumptions are perhaps unrealistic but are made in order to make a direct comparison to the situations analysed previously. Notice also that compared to earlier case, individual countries output is disturbed both by country specific shocks and aggregate shocks. This is of course somewhat ad hoc, but reflects the fact that exchange rate movements do not dampen anymore the effects of aggregate shocks to individual countries.

Assuming that the unions take the European wide average wage $(\overline{w}_t)$ as given, feedback effect is disappeared and the second constraint in the optimization problem is irrelevant. Technically, this is because the ECB *does not condition its monetary policy on the wage setters decision variable* (w_{it}), but on economy wide average $(\overline{w}_t)$. As a result, maximisation yields for each individual country

$$w_{jt} = p_t^e + \sigma_h \tag{48}$$

and σ_h is as in (14). That is, we are back in the discretionary equilibrium. Taking expectations on the relevant variables and solving for rational expectations

equilibrium yields optimal wage rule (for each country) and optimal inflation rule

$$w_t^{emu} = p_{t-1} + \pi^{ecb} + \lambda_{ecb}\overline{\sigma}_h + \sigma_h \tag{49}$$

$$\pi_t^{emu} = \pi^{ecb} + \lambda_{ecb}\overline{\sigma}_h - \frac{\lambda_{ecb}}{1+\lambda_{ecb}}\epsilon_t \tag{50}$$

Individual countries nominal wage responds now to common monetary policy, through the term $\lambda_{ecb}\overline{\sigma}_h$. Given that this term is common to all countries, inflation bias can be eliminated by choosing the target π^{ecb} such that

$$\pi^{ecb} = \pi^* - \lambda_{ecb}\overline{\sigma}_h \tag{51}$$

If each country has the same target inflation (π^*), then actual inflation on average will be on the desired level and the real wage bias depends only upon distortions in the labor markets (σ_h). Formally,

$$\pi_t^{emu} = \pi^* - \frac{\lambda_{ecb}}{1+\lambda_{ecb}}\epsilon_t \tag{52}$$

$$w_t^{emu} = p_{t-1} + \sigma_h \tag{53}$$

Implied output for individual countries and on average will be respectively

$$y_t^{emu} = 1 - \sigma_h + \frac{1}{1+\lambda_{ecb}}\epsilon_t + \epsilon_{jt} \tag{54}$$

$$\overline{y}_t^{emu} = 1 - \overline{\sigma}_h + \frac{1}{1+\lambda_{ecb}}\epsilon_t \tag{55}$$

Both European wide average output and individual countries average output will still be "too" low because of distortions in the labor markets, *but unambiguously higher than in the regime where unions acted truly as strategic leaders of the came* . In fact

$$E\left(y_t^{Tpc}\right) < E\left(y_t^{emu}\right) \tag{56}$$

$$\Leftrightarrow$$

$$\sigma_{pc} > \sigma_h \tag{57}$$

which is always true for positive λ.

Notice that with common monetary policy, the countries individual shocks (ϵ_{jt}) are no more dampened by the monetary policy. The fact that common monetary policy reacts to European wide aggregate shocks only, is likely to *increase the volatility of output in individual countries*, when compared with the case with national monetary policies. There are basically two reasons for this. First, the ECB´s optimal inflation rule reacts to aggregate shocks and while individual countries' supply fluctuations are fully born by each country, as implied by (54). Second, that the wage setters do not adjust wages to aggregate shocks, due to lack of information in this case, the monetary authority´s accommodation makes the real wage fluctuate through the fluctuations in inflation only, as implied by (50)

and (49). If the wage setters would react to individual countries supply shocks (ϵ_{jt}), fluctuation in real wages and thus in output would be jointly determined by the wage setters reaction to idiosyncratic shocks and common monetary policy.

Another possible interpretation for the case analysed here is that increasing product and labor market integration lead industrial unions turn their interest into corresponding industries in the other countries. Again, the situation above could be interpreted in this context by assuming that i represents the particular industry union in different countries and N refers to number of industries. The above analysed de facto Nash game could, then, take place between the industrial unions accross countries, if the ECB did not condition its monetary policy on the average wages of the particular industry. As already argued, in this context, the parameter γ, which reflects the labor demand elasticity, could be interpreted as the firm´s relocation potential; lower the barries of re-location accross countries, higher the labor demand elasticity and thus lower the real wage bias (σ_h). However, if the corresponding industries were important enough from the point of view of European wide aggregate production, the ECB might has an interest to accommodate the specific industries' too high wage demands. Then, we would be again back to the situation of wage setter´s leadership.

Finally, the change in the strategic interaction has implications to optimality of the degree of conservativeness of the ECB. Each governments's loss would be minimized with $\lambda_G = \lambda_{ecb}$, instead of $0 < \lambda_{cb} < \lambda_G$.

Formally, we can write individual government´s utility in the EMU as

$$E_t[V_t^{emu}] = \frac{1}{1-\beta}\frac{1}{2}\left(\left(\frac{1}{1+\lambda_{ecb}}\right)^2 \nu_A^2(\lambda_{ecb}^2 + \lambda_G) + \lambda_G\left(\sigma_h^2 + \nu^2\right)\right) \tag{58}$$

where ν_A^2 is the variance of aggregate shocks, ν^2 is the variance of the idiosyncratic shocks. λ_G, λ_{ecb} are the accommodation parameters of individual governments and the ECB respectively. Minimizing above with respect to λ_{ecb} shows that the loss is minimized when $\lambda_{ecb} = \lambda_G$.

As discussed above, if the monetary policy was conducted by national central banks, the moderately conservative central bank would minimize the loss. In the common monetary policy regime, an inflation target provides a tool to solve inflationary bias problem, without that policymakers need to compromise with flexibility of the policy. In other words, due to the loss of strategic leadership of the unions, an inflation-bias flexibility trade-off is disappeared truly and the central banker can be chosen according to "social preferences".[10]

The situation analysed here is of course simplified and is perhaps most relevant for small countries, where the country specific shocks are only moderately correlated with common European wide shocks. In another extreme, if the aggregate shocks and individual country´s shocks were perfectly and positively correlated

[10]Hagen (1997) argues that ECB would face a larger demand for discretionary monetary stabilization policies, than, individual national monetary authorities.If the individual government´s preferences differ in EMU, our result can be interpreted in favour of Hagen (1997).

the situation, from the stability point of view, would of course be better for the individual countries. Moreover, we have assumed that wages do not respond to country specific shocks. This assumption is consistent with the assumption that wage setters are imperfectly informed about the state of the economy. It may also be not too unrealistic with the empirical evidence, which shows that wages react very little to aggregate demand and supply fluctuations.

7 Conclusions

We have discussed several different monetary policy strategies. In particular, we have analysed the case where the wage setters acted as the leaders of the monetary policy game and derived some implications for the EMU. The first important result of the paper is that unless the labor market is completely centralised or completely decentralised, the wage setters strategic leadership is welfare reducing for the society, compared to the central bank´s precommitment and the traditional discretionary regime. If the central bank has been given explicit inflation target, but the wage setters act as strategic leaders of the monetary policy game, inflation can reach the target level, but the society must still balance between average output performance and stability. That is, appointing a weight conservative central banker is still welfare improving for the society.

The model framework enabled us to derive some EMU implications also. We suggested that the future centralisation of wage bargaining inside the individual EMU countries may lead in the wage setting and monetary policy game, where national confederations have strategic leadership. This was found to be worst situation for all the participants and therefore not desirable for the societies. If the wage setting in individual countries remains uncentralised the national industry unions would take the monetary policy of the European Central Bank as unaffected by their individual decision. In this framework, average output performance in individual countries would be better, when compared to centralised wage bargaining alternative where strategic considerations by unions came into play. Moreover, an explicit inflation target for the ECB would provide an anchor for inflation expectations and remove an inflation bias, without need to relent with flexibility of the monetary policy. Finally, if the deepening product and labor market integration leads industry unions respond to wage demands in different countries, implications of national centralisation of wage bargaining can be extended into European wide context.

8 Recent literature

This paper is most closely related to Barro and Gordon (1983a,b) type of credibility models, that have recently been extended to take into account different wage bargaining practices (Akhand (1992), Cubitt (1992), Skott (1995), Bleaney (1996), Cukierman and Lippi (1998), Velasco and Guzzo (1998)).

This recent research suggests that optimality of precommitment and the central bank´s conservativeness are conditional on a degree of centralisation of wage bargaining and the preferences of the union(s). Typically, these models suggests that the basic results of Barro and Gordon (1983) are not robust in different specifications of the private sector´s behavior and preferences. Cubitt (1992) argues that if the monopoly union cares both inflation and the level of output, the policy precommitment can be harmful and policymakers may benefit from being in the position of Stackelberg follower. Cukierman and Lippi (1998) show that the strategic interaction among many uncoordinated unions and single central bank results in the monetary authorities facing a worse output-inflation trade-off than if they were confronted by a single union only. Velasco and Guzzo (1998) show that the effect of labor market centralization depends heavily on the model specifics. The specification of production technology and the implied relationship between the elasticity of labor demand and the number of unions are the key determinants. They argue that conservative central banker can be costly in terms of employment and output when the wage bargaining is centralised and unions care about inflation.

Explicit inflation target regime has been analysed in Svensson (1997). Svensson (1997) shows in a static framework that inflation bias can be eliminated if the central bank is assumed to have a quadratic loss function with a particular preferred rate of inflation (i.e. an explicit inflation target) below the socially preferred rate. In this case, the inflation bias of Kydland and Prescott induces a rate of inflation that is too low, so that discretionary policy brings inflation back up to the socially desired rate. As in Walsh (1996) linear inflation contract model, also an explicit inflation target *removes inflation bias at no costs of increased output volatility.* In other words, it removes the flexibility-inflation bias trade-off explicit in Barro and Gordon (1983) and Rogoff´s (1985) analysis.

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Mathematical Appendix

A Proof that weight conservative central banker improves welfare of the government

Proposition 1 *A weight conservative central banker improves social welfare when the central bank has an explicit inflation target, while a populist central banker leads always into decrease in social welfare.*

Proof. Let λ_G denote the government´s accommodation parameter and λ_{cb} the central bank´s accommodation parameter. Let $E[V_t]_s$ denote expected loss of the government when the preferences of the central bank and the government are separate and $E[V_t]_c$ when the preferences are the same. When the target inflation for the central bank is chosen so that socially optimal target π^* is achieved, expected loss of the government $E[V_t]_s$ can be written

$$E_t[V_t]_s = \frac{1}{1-\beta}\frac{1}{2}\left(\left(\frac{1}{1+\lambda_{cb}}\right)^2(\lambda_{cb}^2+\lambda_G)v^2+\lambda_G\sigma_{pc}^2\right)$$

Comparing this loss to the case where the central bank shares the preferences of the government, we notice after some manipulations that

$$\begin{aligned} E_t[V_t]_s &> E_t[V_t]_c \\ &\Longleftrightarrow \\ \frac{(\lambda_G-\lambda_{cb})^2}{\lambda_G(1+\lambda_{cb})^2(1+\lambda_G)}v^2 &\geq (\sigma_{pcc}^2-\sigma_{pcs}^2) \end{aligned} \tag{59}$$

where

$$\begin{aligned} \sigma_{pcc} &= \frac{(N-1)(1-\gamma N)}{\left(\frac{1-\lambda_G}{1+\lambda_G}+N(\gamma(N-1)+1)\right)} \\ \sigma_{pcs} &= \frac{(N-1)(1-\gamma N)}{\left(\frac{1-\lambda_{cb}}{1+\lambda_{cb}}+N(\gamma(N-1)+1)\right)} \end{aligned}$$

Lemma 2 *When $\lambda_{cb} > \lambda_G$ the loss of the government is always larger when compared with the case where $\lambda_{cb} = \lambda_G$*

■

Proof. The left hand side of the (59) is always positive in the parameter range of interest. Notice then that σ_{pc} is increasing in λ, so that when $\lambda_{cb} > \lambda_G$ right hand side is always negative. Therefore

$$\begin{aligned} \lambda_{cb} &> \lambda_G \\ &\Rightarrow \\ E_t[V_t]_s &> E_t[V_t]_c \end{aligned}$$

This completes the proof that populist central banker cannot be welfare improving.
■

Lemma 3 *There exist a non-empty range of* $0 \leq \lambda_{cb} < \lambda_G$*, where*

$$E_t[V_t]_s < E_t[V_t]_c$$

Proof. Recall that

$$E_t[V_t]_s = \frac{1}{1-\beta}\frac{1}{2}\left(\left(\frac{1}{1+\lambda_{cb}}\right)^2(\lambda_{cb}^2+\lambda_G)v^2+\lambda_G\sigma_{pc}^2\right)$$

Taking the the derivative with respect to λ_{cb}, we obtain

$$\frac{\partial E_t[V_t]_s}{\partial \lambda_{cb}} = \frac{1}{1-\beta}\frac{1}{2}\left(2\frac{\lambda_{cb}-\lambda_g}{(\lambda_{cb}+1)^3}v^2+\lambda_G\frac{\partial \sigma_{pc}^2}{\partial \lambda_{cb}}\right)$$

Remembering that $\frac{\partial \sigma_{pc}^2}{\partial \lambda_{cb}} > 0$, a necessary condition that the derivative is $\frac{\partial E_t[V_t]_s}{\partial \lambda_{cb}}$ is zero within the parameter range of interest is that $\lambda_{cb} < \lambda_g$. Notice then that

$$\begin{aligned}\frac{\partial E_t[V_t]_{\lambda_{cb}\to\lambda_g}}{\partial \lambda_{cb}} &> 0\\ \frac{\partial E_t[V_t]_{\lambda_{cb}\to 0}}{\partial \lambda_{cb}} &< 0\end{aligned}$$

Then it is clear that $\frac{\partial E_t[V_t]}{\partial \lambda_G}$ changes the sign between $0 \leq \lambda_{cb} < \lambda_G$, so that appointment of conservative central banker is welfare improving for the government.
■

Proposition 4 *Higher the distortions in the labor markets, more conservative the central bank needs to be in order to minimize a loss of the government.*

Proof. This can be easily seen by noticing that

$$\frac{\partial E_t[V_t^{Tpc}]}{\partial \sigma_{pc}} > 0$$

and that

$$\frac{\partial \sigma_{pc}}{\partial \lambda_{cb}} > 0$$

■