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Monetary Policy Department
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Monetary Policy Delegation, Labour Market Structure and Fiscal-Monetary Policy Coordination

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Abstract

We study monetary policy delegation in a framework where fiscal policy is determined endogenously and wages are negotiated by trade unions who face a trade-off between real wages and employment. If the median trade union voter is a senior member the nominal wages are too high to guarantee full insider employment. The fiscal authority can subject the central bank to institutional arrangements. The optimal choice of central bank preferences shows a central banker who is more inflation averse, but not infinitely so, than the fiscal authority. This happens because employment and government expenditures are not invariant to changes in the monetary regime. If the fiscal authority gives the central bank to an inflation target, the optimal target is contingent upon both the fiscal authority's and the trade union's preferences. Moreover, the fiscal authority's gain from inflation targeting is highest if the median union voter has no employment objective. When the union cares about employment, both fiscal and monetary policies become subject to time-inconsistency problems. In equilibrium, the overall welfare under inflation targeting can be lower than under discretion. However, when the union's employment objective becomes sufficiently important, the gain starts to increase. Thus, we find a U-shaped relationship between the gain from inflation targeting and the trade union's weight on employment.

Key words: Trade Union Behaviour, Fiscal-Monetary Coordination, Inflation Targeting.

Rahapolitiikan delegointi, työmarkkinoiden rakenne ja raha- ja finanssipolitiikan yhteensovittaminen

Suomen Pankin keskustelualoitteita

Olli Castrén
Rahapolitiikan osasto

Tiivistelmä

Tässä artikkelissa analysoidaan rahapolitiikan optimaalista delegointia mallissa, jossa finannsipolitiikka on määritelty endogeenisesti ja palkanasetannasta vastaavat ammattiliitot valitsevat reaalipalkan ja työllisyyden välillä. Jos ammattiliiton mediaaniäänestäjä on vanhempi jäsen, liitto valitsee nominaalipalkan joka on liian korkea taatakseen täystyöllisyyden liiton kaikille jäsenille. Finannssiviranomainen (FV) voi suunnitella optimaalisen keskuspankki-instituution. Jos FV valitsee keskuspankin preferenssit, optimaalinen keskuspankki on enemmän, mutta ei äärettömän paljon, inflaationvastainen kuin FV. Tämä johtuu siitä, että tasapainossa työllisyys ja julkinen kulutus eivät ole muuttumattomia suhteessa rahapolitiikan regiimin muutoksiin. Jos taas FV asettaa keskuspankille inflaatiotavoitteen, optimaalinen tavoite on riippuvainen sekä FV:n että ammattiliiton preferensseistä. Myös FV:n hyöty inflaatiotavoitteesta riippuu ammattiliiton käyttäytymisestä. Hyöty on suurimmillaan, kun ammattiliiton mediaanijäsen ei anna lainkaan painoa työllisyystavoitteelle. Mikäli liitto arvostaa työllisyyttä, sekä finannsi- että rahapolitikka kärsivät aikaepäjohdonmukaisuusongelmasta. Inflaatiotavoite ei ole rittävä eliminoimaan molempia ongelmia, ja tasapainossa hyvinvointi saattaa olla alhaisempi kuin jos inflaatiotavoitetta ei ole. Jos työllisyystavoite on riittävän tärkeä, hyöty alkaa kuitenkin kasvaa. Inflaatiotavoitteesta koituvan hyödyn ja ammattiliiton työllisyyspreferenssin välillä vallitsee U:n muotoinen riippuvuus.

Asiasanat: Ammattiliiton käyttäytyminen, Finanssi- ja rahapolitiikan yhteensovittaminen, Inflaatiotavoite.

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1 Introduction

During the 1990's, reforming the monetary policy institutions has become an increasingly popular means of achieving price stability in the OECD countries. Many reforms have taken the form of increased central bank independence and general openness in the day-to-day conduct of monetary policy. In addition, many countries with turbulent experiences in various kinds of fixed exchange rate regimes have chosen to set formal inflation targets.[1] The analytical features of inflation targeting, which originate from the analysis of Persson and Tabellini (1993), Walsh (1995a) and Svensson (1997), are indeed highly plausible. When applied in the standard time-inconsistency framework by Barro and Gordon (1983), an optimal inflation target for the central bank successfully eliminates the inflation bias that characterises monetary policy under government's discretion. Better still, inflation targeting avoids the well-known credibility-flexibility tradeoff which arises when monetary policy is delegated to a conservative central banker (Rogoff, 1985). However, several authors have recently challenged the result that simple policy delegation by inflation targeting alone would be sufficient to eliminate the inflation bias. Svensson himself (1997) observed that in the presence of output persistence, inflation targeting *per se* cannot deliver the *ex ante* optimal outcome. The same result has been shown to apply if the inflation bias is stochastic rather than deterministic (Herrendorf and Lockwood 1997), or if there is uncertainty about the monetary authority's preferences (Muscatelli, 1998). It therefore seems that in a more general set-up the central bank needs to be subjected to additional "institutional devices" in order to reach the optimal outcome.

The standard framework for analysing monetary policy reforms assumes that the central bank plays against a large number of forward-looking wage setters who are not able to coordinate their actions. Another strand of the literature in monetary policy games focuses on the interaction between the fiscal and the monetary authorities. In a seminal paper, Alesina and Tabellini (1987) studied the case where government expenditures can be financed either by taxes or by seignorage revenues. They found that if the central bank is able to commit to a low inflation policy rule, the fiscal authority must respond by raising taxes if it wants

[1] Explicit inflation targets have recently been adopted in New Zealand, the UK, Canada, Sweden, Finland and Spain. Moreover, the European Central Bank, which will be launched 1st of January 1999, is likely to follow at least partially a monetary policy strategy based on inflation targeting.

to avoid excessive reductions in government spending. However, for the fiscal authority, the resulting policy mix can imply a lower welfare than under the original discretionary equilibrium.

We argue that explicitly including the fiscal response is essential if one wants to achieve a realistic description of monetary policy delegation. In most cases, the delegation decision is made by the democratically elected parts of the society, like the parliament and/or the government. Because these authorities also determine the stance of fiscal policy in the economy, it is intuitively obvious that the proposed monetary reform should take into account how fiscal policy will respond to the new regime. This is particularly true in the cases where the monetary authority remains formally subordinated (accountable) to the fiscal authority after the delegation has taken place. In this paper we analyse optimal monetary delegation under a fiscal-monetary framework. More specifically, we assume that the fiscal authority attempts to increase its discretionary welfare either by appointing a central banker with suitable preferences or by subjecting the central bank to an inflation target. In addition, in our model the features of the underlying labour market structure play an important role. Following the recent work by Herrendorf and Neumann (1998), we assume that nominal wages are negotiated in the labour market which consists of a continuum of small and identical trade unions. Each union cares about real wages and employment among its own members. However, the weight assigned by different trade union members on the two objectives is not necessarily identical. This is because senior trade union members often face a lower risk of unemployment than the more junior members, due to the practice of "inverse layoffs" (see Oswald, 1993). If the median voter in each trade union is a senior member, the representative union's optimal choice of nominal wages leaves a part of the junior members unemployed, thus taking the economy's natural rate of employment further below the full employment level.

Under such a setup, it turns out that the choice of the optimal central bank preferences implies a tradeoff between the gain from lower inflation and the loss from lower employment and government spending. Therefore, we generalise Rogoff's (1985) dilemma in an entirely non-stochastic framework. Furthermore, we show that if the fiscal authority subjects the central bank to an inflation target, the optimal inflation target imposes a solution to the inflation-employment-expenditures tradeoff. Moreover, the optimal target is shown to be contingent upon both the fiscal authority's and the trade unions' preferences. Hence, the optimal inflation target becomes "flexible" compered to a target which

only focuses on the central bank's preferences.[2] However, because of the multiplicity of the trade union objectives, both fiscal and monetary policy become subject to time-inconsistency problems in the model. This implies that inflation targeting as a single instrument cannot induce the fiscal authority's *ex ante* optimal outcome, unless the fiscal authority itself is able to commit to an optimal tax rate. Only in the case where the trade union has no employment objective at all it does not form expectations about taxes, and inflation targeting can implement the optimal outcome. More generally, we find a U-shaped relationship between the weight assigned by the trade unions on the employment objective and the fiscal authority's gain from inflation targeting. Inflation targeting increases fiscal welfare most when the trade unions are fully dominated by either senior members (in which case the unions do not care about employment) or junior members (in which case they assign no weight on the real wage objective). This result can be compered to the findings of Calmfors and Driffill (1988) and Cukierman and Lippi (1998), who argue that employment tends to be highest either under a fully centralised or a fully decentralised wage bargaining structure.

The rest of this paper proceeds as follows. Section 2 specifies the model. In section 3, we show how the fiscal and monetary time-inconsistency problems arise through the trade union´s optimal choice of nominal wages. The optimal delegation regimes are analysed in section 4. Section 5 concludes.

2 The Model

2.1 Trade Union Objectives and the Natural Rate of Employment

Following Alesina and Tabellini (1987), we assume that a typical firm's labour demand, which results from profit maximisation under a Cobb-Douglas technology with labour as the only variable input, can be expressed as follows:

[2] Svensson (1998) analyses flexible inflation targeting in a model where the central bank faces a tradeoff between inflation and the exchange rate.

(2.1) $$l = p - w - \tau$$

In (2.1), l = employment, p = price level, w = nominal wage and τ = distortionary tax levied on firms' total revenues (all in logs). With p_{t-1} and w_{t-1} normalised to zero, p also equals inflation and w equals the growth rate of nominal wages. Employment falls with an increase in the real wage, w-p, but increases when taxes are cut. Nominal wages are negotiated in the labour market, which is composed of a continuum of trade unions (TUs) and firms. Firms are competitive in the product market and workers cannot move accross sectors. Each TU is assumed to have monopoly power over wage setting in its sector. The TUs are assumed to care about two objectives, real wages and employment among their own members. The latter implies that the TU dislikes deviations of employment from a target level l^*, which corresponds to the level where all union members are employed. For the TU, an employment level above its own target level may result in a welfare loss, because it increases the demand for labour from non-union members. In this respect, the model captures a version of the insider-outsider approach to the labour market (following Lindbäck and Snower, 1986).[3] More specifically, a typical TU aims at optimising the following loss function:

(2.2) $$\frac{1}{2}\{(w - p - u^*)^2 + \chi(l - l^*)^2\}$$

In (2.2), χ is the relative weight assigned by the TU on the employment objective. When χ is finite, the TU is willing to tolerate some unemployment even for its own members (insiders) in exchange to higher wages. Following Herrendorf and Neumann (1998), we argue that this characteristic can illustrate the conflict between the senior and the junior members of the TU. The conflict arises because a senior worker faces a lower risk of getting unemployed, due to the common practice of inverse layoffs ("last in-first out").[4] Consequently, a senior worker

[3] Previous analysis following this tradition include Jensen (1992), Schaling (1995) and Herrendorf and Lockwood (1997), who all analyse the case of a single policymaker (the central bank) playing against a TU who has multiple objectives.

[4] See Oswald (1993) for an empirical analysis of the practice of inverse layoffs. As a critique towards this approach one can think about the outside option for the TU members which is provided by the social security system. For example, in Nordic countries it has occasionally turned out that sufficiently attractive pension conditions can give the senior workers an incentive to leave first, thus effectively improving the junior workers' employment security.

typically has a lower χ than a junior worker, who is more concerned about TU employment. The TU chooses the nominal wage rate w to minimise (2.2). Assuming that the seniors are in majority, the median voter who chooses the TU's nominal wage comes from this group, and therefore some junior workers end up unemployed.

We define the natural rate of employment, labeled $\tilde{l}$, as the rate which results from the TU's optimal wage setting decision, in the absence of policy surprises. From the TU's optimisation problem we get the TU's reaction function. Substituting this into (2.1), and eliminating policy surprises, gives the natural rate of employment:

$$
\begin{aligned}
& w = p^e - \gamma\tau^e - \gamma v^* \\
& \tilde{l} = -(1-\gamma)\tau + \gamma v^* < 0 \\
& \gamma \equiv \frac{\chi}{1+\chi}, v^* \equiv l^* - \frac{u^*}{\chi}
\end{aligned}
\tag{2.3}
$$

It turns out that when χ is finite, implying that $0 < \gamma < 1$ and that the TU cares about employment, the TU forms expectations on inflation *and* taxes. The economy's full employment level will below be normalised to zero. Therefore, $l^*<0$ by definition. It follows that when $\chi \to \infty$, the natural rate of *unemployment* equals l^*, the TU's employment target. In that case the TU's choice of nominal wages fully reflects the preferences of junior members and only outsiders remain unemployed.

2.2 Specification of the Fiscal-Monetary Interaction

The model has two policymakers. The fiscal authority (FA) chooses the tax rate, whereas the central bank (CB) chooses the rate of growth of money supply.[5] The policymakers' loss functions, L^{FA} and L^{CB}, respectively, are specified as follows:

[5] In the latter case, it is assumed that inflation can be set directly by choosing money growth.

$$a) L^{FA} = \frac{1}{2}\{p^2 + \delta_1 l^2 + \delta_2 (g - \bar{g})^2\}$$

(2.4)

$$b) L^{CB} = \frac{1}{2}\{p^2 + \mu_1 l^2 + \mu_2 (g - \bar{g})^2\}$$

Both policymakers dislike deviations of actual employment *(l)* from full employment level (zero), which is higher than the TU's employment target l^*.[6] They also dislike deviations of public spending *per capita* (g) and inflation (p) from their respective targets $\bar{g}$ and zero.[7] If the government expenditure target $\bar{g}$ is directly related to the size of the public sector, then the formulation of (2.4) implies that the policymakers get positive utility from governing larger organisations. Therefore, including the public spending objective in (2.4) can be motivated if the policymakers have "empire building incentives". The two authorities are assumed to disagree about the relative importance of the different targets: $\mu_i \neq \delta_i$ for $i = 1,2$. Specifically, we assume that $\delta_i \geq \mu_i$, $i = 1,2$, so that the CB assigns a higher relative weight on inflation than the FA does. Because the TU's optimal choice of nominal wages renders the natural rate of employment below the policymakers' target level, the policymakers have incentives to boost employment by generating policy surprises after the wages have been set. Because the TU negotiates wages on the basis of its expectations about taxes and inflation, both fiscal and monetary authorities face a time-inconsistency problem in the model.

Fiscal and monetary polices are brought interdependent through the government budget constraint. We ignore here the dynamic aspects of the budget constraint, and therefore with no public debt, it is required that expenditures equal tax revenues plus seignorage financing.[8]

(2.5) $$g = \tau + p$$

---

[6] Herrendorf and Neumann (1998) suggest an alternative formulation where the policymakers' objectives represent a weighted sum of individual workers' objectives. In contrast, our formulation implies that the fiscal and the monetary authorities also care about the employment of the non-unionised workers.

[7] More specifically, zero corresponds to the optimal inflation rate if the weight given to government expenditures were zero and the CB faced no tradeoff between inflation and expenditures. This target rate will generally differ from the explicit inflation target $\hat{p}$, which will be introduced below.

[8] See Beetsma and Bovenberg (1996) for an analysis of two-period debt dynamics in a related model.

In (2.5), g denotes the ratio of public expenditures to output. Taxes are assumed to have no demand effects, *i.e.,* any tax induced change in government expenditures is exactly offset by an equivalent change in private expenditures. Therefore, taxes affect the economy only through their distortionary effects on the firms' decisions.

3 The Time-Inconsistency Problem

In this section, we identify the distortions which arise from the interaction between the TU and the fiscal and the monetary authorities under the dual time-inconsistency problem.

3.1 Commitment to Optimal Fiscal and Monetary Policy Rules

We analyse first the case where the policymakers are able to commit to optimal policy rules, before the TU forms its expectations. The timing of events under such a regime is as follows: (i) The FA and the CB simultaneously commit to *ex ante* optimal policy rules. (ii) The TU rationally chooses nominal wages. (iii) Employment results from the firms' labour demand (2.1), and government expenditures result from the budget constraint (2.5). Under commitments, the two policymakers' first order conditions can be obtained by minimising (2.4a,b) subject to (2.1), (2.5) and the restriction that $p=p^e$ and $\tau=\tau^e$. After rearranging, we obtain:

$$(3.1)\qquad a)\tau = \frac{\delta_2(\bar{g}-p^e)+\delta_1(1-\gamma)\gamma v^*}{\delta_1(1-\gamma)^2+\delta_2}$$

$$b)p = \frac{\mu_2}{1+\mu_2}(\bar{g}-\tau^e)$$

Solving (3.1a) and (3.1b) together gives the equilibrium inflation and tax rates under commitments. These values in turn determine the equilibrium values of employment and government expenditures:

$$a)\, p^C = \frac{\mu_2 \delta_1 (1-\gamma)}{\delta_2 + \delta_1 (1-\gamma)^2 (1+\mu_2)} ((1-\gamma)\bar{g} - \gamma v^*)$$

$$b)\, \tau^C = \bar{g} - \frac{\delta_1 (1+\mu_2)(1-\gamma)}{\delta_2 + \delta_1 (1-\gamma)^2 (1+\mu_2)} ((1-\gamma)\bar{g} - \gamma v^*)$$

(3.2) $\Rightarrow$

$$c)\, l^C = (p^C - w - \tau^C) = -\frac{\delta_2}{\delta_2 + \delta_1 (1-\gamma)^2 (1+\mu_2)} ((1-\gamma)\bar{g} - \gamma v^*)$$

$$d)\, g^C = \tau^C + p^C = \bar{g} - \frac{\delta_1 (1-\gamma)}{\delta_2 + \delta_1 (1-\gamma)^2 (1+\mu_2)} ((1-\gamma)\bar{g} - \gamma v^*)$$

Note that the inflation rate under commitments is positive, implying that the equilibrium outcome constitutes a solution to the tradeoff between low inflation and the need of financing some expenditures through seignorage. Finally, substituting (3.2a,c,d) into (2.4a), and rearranging, yields the FA's equilibrium welfare loss under commitments:

$$(3.3) \qquad L^{FA,C} = (p^C)^2 \left[1 + \frac{\delta_1 \delta_2 (\delta_1 (1-\gamma)^2 + \delta_2)}{(\mu_2 \delta_1 (1-\gamma))^2} \right]$$

However, because the labour market distortions render the natural rate of employment below zero, the policymakers have incentives to generate inflation surprises after the TU has formed its expectations. Therefore, the commitment equilibrium does not constitute a time-consistent solution in general.

3.2 Monetary and Fiscal Policy under Discretion

Under discretion, the policy outcome is a Nash equilibrium and therefore it is time-consistent by construction. The game now proceeds as follows: (i) In the first stage, the TU rationally chooses the nominal wage. (ii) In the second stage, the FA chooses the tax rate and the CB simultaneously chooses the inflation rate, both taking each others' and the TU's choice as given. (iii) Employment results from the firms' labour demand (2.1) and government expenditures result from the budget constraint (2.5). The two policymakers' first-order conditions are obtained by minimising (2.4a,b), with respect to (2.1) and (2.5):

$$a)\frac{\partial L^{FA}}{\partial \tau} = -\delta_1(p^e - w - \tau) + \delta_2(p^e + \tau - \bar{g}) = 0$$

(3.4)

$$b)\frac{\partial L^{CB}}{\partial p} = p + \mu_1(p - w - \tau^e) + \mu_2(p + \tau^e - \bar{g}) = 0$$

Substituting in the TU's optimal choice of nominal wages, taking expectations through the resulting expression, and rearranging, yields the following expressions for expected taxes and expected inflation under discretion:

$$a)\tau^e = \frac{\delta_2(\bar{g} - p^e) + \delta_1\gamma v^*}{\delta_1(1-\gamma) + \delta_2}$$

(3.5)

$$b)p^e = \frac{1}{1+\mu_2}\{(\mu_1(1-\gamma) - \mu_2)\tau^e - \mu_1\gamma v^* + \mu_2\bar{g}\}$$

The policymakers observe the expectations and set the inflation and tax rates accordingly. The time consistent Nash equilibrium can then be obtained by solving (3.5a) and (3.5b) together, and using the employment and government expenditures relations (2.1) and (2.5), respectively:

$$a)p^D = \frac{\mu_1\delta_2 + \delta_1\mu_2}{\delta_2 + (1-\gamma)(\delta_1(1+\mu_2) + \mu_1\delta_2)}((1-\gamma)\bar{g} - \gamma v^*)$$

$$b)\tau^D = \bar{g} - \frac{\delta_1(1+\mu_2) + \mu_1\delta_2}{\delta_2 + (1-\gamma)(\delta_1(1+\mu_2) + \mu_1\delta_2)}((1-\gamma)\bar{g} - \gamma v^*)$$

(3.6) $\Rightarrow$

$$c)l^D = p^D - w - \tau^D = -\frac{\delta_2}{\delta_2 + (1-\gamma)(\delta_1(1+\mu_2) + \mu_1\delta_2)}((1-\gamma)\bar{g} - \gamma v^*)$$

$$d)g^D = \tau^D + p^D = \bar{g} - \frac{\delta_1}{\delta_2 + (1-\gamma)(\delta_1(1+\mu_2) + \mu_1\delta_2)}((1-\gamma)\bar{g} - \gamma v^*)$$

Under discretion, the inflation rate is higher than under commitment whenever the CB assigns some weight on any objective other than inflation (*i.e.*, when $\mu_1 > 0$ and/or $\mu_2 > 0$).[9] On the other hand, the

[9]A positive weight on employment means that the CB has an incentive to generate surprise inflation, whenever the natural rate of employment is below zero. In the equilibrium, however, these incentives are correctly anticipated by the TU in the first period, and therefore the CB is not fully successful in its attempt to boost employment.

discretionary tax rate depends on the respective weights the FA puts on the employment and expenditure objectives (δ_1 vs. δ_2), as a high (low) relative weight on employment implies a low (high) tax rate.[10] The TU's weight on employment, χ, affects the equilibrium outcomes in the following way. Through γ, the time-consistent tax rate is increasing and the inflation rate is decreasing in χ. If the median TU member is a senior (with a finite χ), the TU's choice of nominal wages causes unemployment among the junior TU members. The natural rate of employment is then further away from the policymakers' target level, and consequently the policymakers face higher incentives to generate policy surprises in form of lower taxes and higher inflation.[11] Finally, substituting (3.6a,c,d) into (2.4a), and rearranging, gives the FA's equilibrium loss under discretion:

$$L^{FA,D} = (p^D)^2\left[1+\frac{\delta_1\delta_2(\delta_1+\delta_2)}{(\mu_1\delta_2+\mu_2\delta_1)^2}\right] \tag{3.7}$$

We can now analyse the FA's *gain* from commitments by studying the difference between the benevolent FA's equilibrium loss under discretion (equation 3.7) and commitments (equation 3.3). The first term in the squared brackets (the inflation rate) is higher under discretion, whereas the second term (the deviation of employment and expenditures from their respective target levels) is lower. A commitment by a CB who puts a low relative weight on the employment and expenditure objectives forces the FA to raise taxes more than it is optimal. The gain to the FA from reduced inflation can then be more than offset by the loss in terms of employment and expenditures. On the other hand, a FA that assigns a high relative weight on the expenditure objective prefers higher taxes and therefore it renders employment further below the target level. The

[10] Furthermore, a higher weight assigned by the CB on the expenditure objective (μ_2) means that taxes can be set lower, as the CB is willing to finance a larger share of the expenditure objective through seignorage.

[11] This result is in contrast to Herrendorf and Neumann (1998), who assume that the CB is benevolent and minimises a weighted sum of senior and junior workers' objective functions. In their model the inflation bias increases when the share of junior workers gets higher, *i.e.* they implicitly suggest a positive relationship between γ and p^D. This happens because a larger share of junior members gives the benevolent CB higher incentives to generate policy surprises in order to boost employment. In our model the CB simply takes the realised natural rate of employment as given and does not care about the underlying distribution of the TU members *per se*. From (2.3) it is obvious that $\partial\tilde{l}/\partial\gamma > 0 \Rightarrow \partial\tilde{l}/\partial\chi > 0$, *i.e.*, the natural rate of employment is lower when the median worker is senior.

CB may then be forced to generate higher inflation rate than it would optimally do in order to boost employment.

The effect of changes in TU preferences on the gain from commitments is illustrated in Figure 1, where we have γ on the horizontal axis and the FA's gain from commitment (defined as $G^{FA,C}=L^{FA,D}-L^{FA,C}$) on the vertical axis. In the simulation, the difference between the CB's and the FA's preferences (μ_i and δ_i) is chosen to be relatively large so that in the absence of a TU employment objective (*i.e.*, when χ and γ equal zero), commitments are not welfare improving (see Alesina and Tabellini, 1987). It turns out that this outcome is sensitive to assumptions about the underlying labour market structure. More specifically, when γ increases the gain from mutual commitments becomes positive. This happens because the fiscal time-inconsistency problem comes into the picture when the TU cares about employment, thus increasing the discretionary welfare loss. When γ goes to unity, the gain starts to fall. Because the monetary time-inconsistency problem gets less severe when γ increases, the loss from commitment by a CB which has "too low" preferences starts to dominate the outcome from the FA's point of view.

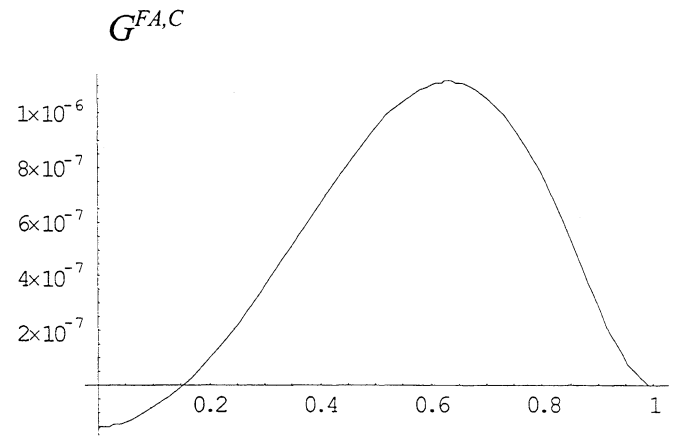

Figure 1: Gain from Commitment under Different Trade Union Preferences

We now turn to investigate whether it is possible for the FA to design a CB institution that can improve upon the discretionary outcome (3.7). From the FA's point of view this would optimally involve reducing the

inflationary bias without generating any excessive losses in terms of other objectives.

4 Optimal Monetary Policy Delegation and the Fiscal Response

Above it was shown that under discretion, the policy mix is inefficient for two reasons. First, the policymakers are generally not able to commit to optimal policy rules. Second, even if commitments were possible, they would not necessarily be welfare-improving if there is a dispute between the two policymakers about the relative importance of the government expenditure objective. In this section, we study whether an equilibrium where the FA *delegates* monetary policy to a CB can constitute a genuine welfare improvement to the FA compared to the discretionary outcome.

4.1 Delegation to a Conservative Central Bank

In the previous section we have seen how a commitment by a CB who assigns a higher relative weight on the inflation objective than the FA does may result in a welfare loss for the FA. However, in a model with no explicit fiscal policy, Rogoff (1985) found that society's discretionary welfare increases if monetary policy is delegated to a more inflation averse central banker.[12] In our two-authority framework, a central banker who puts a *zero* weight on the employment objective (μ_1=0) would be successful in eliminating the inflationary bias under discretion.[13] However, under asymmetric preferences, delegating monetary policy to such an ultra-conservative CB would not correctly take into account the

[12] However, Rogoff also found that in the presence of stochastic shocks, such a "conservative" CB shows insufficient response to the shocks. Therefore, the model gives raise to a credibility-flexibility trade-off. Debelle and Fischer (1994) analysed the Rogoff solution in a fiscal-monetary setup.

[13] Comparing the CB's reaction functions under commitment and under discretion (equations 3.1b and 3.4b) reveals that the difference between the two (the inflation bias under discretion) is given by: $p^D(\tau) - p^C(\tau) = \frac{\mu_1}{1+\mu_2}[(1-\gamma)\tau - \gamma v^*] > 0$. Clearly, by appointing a CB governor with $\mu_1 = 0$, the FA could eliminate this inflation bias.

fiscal response, and in the equilibrium the FA's welfare may well be reduced.

In Figure 2, we have used numerical simulation methods to illustrate how the FA would optimally delegate monetary policy to a more inflation averse CB when taxes are determined endogenously and the labour market is characterised by inverse layoffs. As an alternative to the standard Rogoff case we study how changes in μ_2, the weight assigned by the CB on the expenditure objective, affect the FA's welfare. The vertical axis shows the FA's loss under discretion (equation 3.7), and the horizontal axis measures μ_2 (in the calibration, the value of δ_2, which denotes FA's weight assigned on the expenditure objective, has been fixed at 0.02). The loss is minimised when μ_2 lies slightly below δ_2.

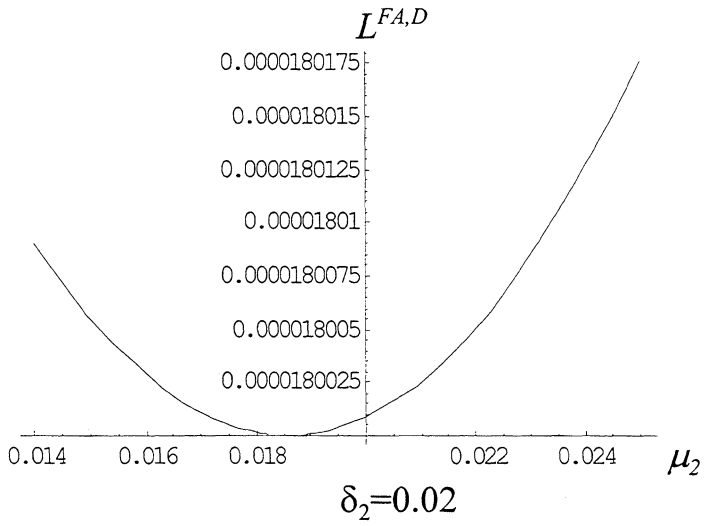

Figure 2: Optimal Choice of Central Bank Preferences under Endogenous Fiscal Policy

Therefore, under an overly conservative CB, who puts too little weight on the expenditure objective, the gain from lower inflation would be more than offset by losses in terms of the other objectives even in the absence of output shocks.

4.2 Delegation by Inflation Targeting

In a similar credibility-flexibility framework than Rogoff, Walsh (1995a) has suggested that by subjecting the central bank's head to an optimal performance contract, the inflationary bias can be eliminated with no adverse effects on shock stabilisation.[14] Svensson (1997) showed that in a static model a Walsh contract is equivalent to giving the CB an explicit inflation target.[15] The target can be enforced by a simple dismissal rule, which is triggered whenever the target is not hit.[16] Huang and Padilla (1995) generalised Walsh's result in a model with endogenous taxes and atomistic wage-setting. They argued that if the contract requires that the FA must give the CB a transfer payment in order to guarantee incentive-compatibility, the targeted equilibrium is not *ex post* optimal to the FA. In what follows, we provide a critical examination of this result by applying the inflation targeting approach in a more general framework where both FA's and wage setters' preferences are determined endogenously.

In order to analyse the power of the optimal institutions in improving the FA's welfare, it is convenient first to determine the FA's *ex ante* optimal outcome. From the previous sections it follows that such an equilibrium would require that the FA alone chooses both policy instruments *and* that it is able to commit to both optimal fiscal and monetary policy rules. Under such a scenario, the gain to the FA from reduced inflation would more than offset the loss from lower employment and government expenditures. Analytically, the optimal outcome can be derived by modifying equation (3.2a,b), the equilibrium inflation and tax rates under commitments, and equation (3.3), the equilibrium welfare loss under commitments, by replacing μ_2 with δ_2:

---

[14] This can be achieved because the Walsh contract increases the CB's cost of generating surprise inflation by a constant amount accross all states of nature.

[15]Svensson also found that under output persistence, an inflation target must be supplemented by a conservative CB in order to yield the same outcome than a Walsh contract. Herrendorf and Lockwood (1997) show that the same holds in a static model if the inflation bias is stochastic rather than deterministic. Finally, in an analysis where the FA faces uncertainty about the CB preferences, Muscatelli (1998) showed that a contract and an inflation target yield different results. In particular, the contract turned out to generate higher welfare while neither institution alone was able to deliver the optimal outcome.

[16]See Canzoneri, Nolan and Yates (1997) and Walsh (1995b) for a discussion about the design and implementation of such dismissal rules.

$$
\begin{aligned}
&a)\, p^{OPT} = \frac{\delta_1\delta_2(1-\gamma)}{\delta_2+(1-\gamma)^2\delta_1(1+\delta_2)}((1-\gamma)\bar{g}-\gamma v^*) \\
&b)\, \tau^{OPT} = \bar{g}-\frac{\delta_1(1-\gamma)(1+\mu_2)}{\delta_2+(1-\gamma)^2\delta_1(1+\delta_2)}((1-\gamma)\bar{g}-\gamma v^*) \\
&c)\, L^{FA,OPT} = (p^{OPT})^2\left[1+\frac{\delta_1(1-\gamma)^2+\delta_2}{\delta_1\delta_2(1-\gamma)^2}\right]
\end{aligned}
\tag{4.1}
$$

In (4.1), the superscript *"OPT"* refers to the socially optimal outcome. We now ask: is it possible for the FA to design an optimal inflation target for the CB so that the resulting outcome would allow the FA to move from the decentralised, discretionary equilibrium as specified in (3.7) to the *ex ante* optimal equilibrium as specified in (4.1)? To find a solution to this question, we start with modifying the CB's loss function (2.4b) by including an explicit inflation target $\hat{p}$. This is assumed to be optimally chosen by the FA in an initial "institution design stage", which takes place before the TU negotiates the nominal wages:

$$
L^{CB,T} = \frac{1}{2}[(p-\hat{p})^2+\mu_1 l^2+\mu_2(g-\bar{g})^2]. \tag{4.2}
$$

In (4.2), the superscript T refers to inflation targeting. The policymakers operate under discretion, and the resulting equilibrium is a Nash equilibrium as before. However, because $\hat{p}$ is chosen by the FA, the CB can be said to enjoy *instrument independence,* but not *goal independence,* in its choice of inflation rate.[17] Following the steps which lead to the discretionary equilibrium above, we obtain the equilibrium outcomes, for a given $\hat{p}$, as follows:

$$
\begin{aligned}
&a)\, p^T = \hat{p}+\frac{\mu_1\delta_2+\delta_1\mu_2}{\delta_2+(1-\gamma)(\delta_1(1+\mu_2)+\mu_1\delta_2)}((1-\gamma)(\bar{g}-\hat{p})-\gamma v^*) \\
&b)\, \tau^T = \bar{g}-\frac{\delta_2\hat{p}+(\delta_1(1+\mu_2)+\mu_1\delta_2)}{\delta_2+(1-\gamma)(\delta_1(1+\mu_2)+\mu_1\delta_2)}((1-\gamma)(\bar{g}-\hat{p})-\gamma v^*) \\
&\Rightarrow \\
&c)\, l^T = -\frac{\delta_2}{\delta_2+(1-\gamma)(\delta_1(1+\mu_2)+\mu_1\delta_2)}((1-\gamma)(\bar{g}-\hat{p})-\gamma v^*) \\
&d)\, g^T = \bar{g}-\frac{\delta_1}{\delta_2+(1-\gamma)(\delta_1(1+\mu_2)+\mu_1\delta_2)}((1-\gamma)(\bar{g}-\hat{p})-\gamma v^*)
\end{aligned}
\tag{4.3}
$$

[17] This terminology was initiated by Fischer (1995) and it relates the delegation regime directly to the more traditional principal-agent models where the agent has the control, but not ownership, of the asset which remains the principal's property.

To find the optimal $\hat{p}$, we substitute the equilibrium outcomes (4.3a,c,d) into the FA's loss function (2.4a) where $\hat{p}$ does *not* enter directly. Minimising this function with respect to $\hat{p}$, and rearranging, gives:

$$(4.4)\quad \hat{p} = -\frac{(\delta_1(1-\gamma)+\delta_2)(\mu_1\delta_2+\mu_2\delta_1)-\delta_1\delta_2(\delta_1+\delta_2)}{[\delta_1(1-\gamma)+\delta_2]^2+\delta_1\delta_2(\delta_1+\delta_2)(1-\gamma)}((1-\gamma)\bar{g}-\gamma v^*)$$

$$\frac{\partial\hat{p}}{\partial\bar{g}}<0;\frac{\partial\hat{p}}{\partial\mu_i}<0;\frac{\partial\hat{p}}{\partial\gamma}>0\Rightarrow\frac{\partial\hat{p}}{\partial\chi}>0\,.$$

We assume that μ_1 and μ_2 are not "too small", so that the sign of (4.4) is negative.[18] It turns out, that in our fiscal-monetary framework the optimal inflation target is more complex than in the original model of Svensson, where the role of the optimal institution was simply to eliminate the inflation rate which is in excess of the "socially best" rate. In contrast to such "strict" inflation targeting, in the presence of a government expenditure objective the FA applies "flexible" inflation targeting. The flexible target constitutes an optimal solution to the trade-off between the gain from lower inflation and the loss from lower employment and lower expenditures.

What are the features of the optimal flexible inflation target? First, the optimal target is the lower the higher is $\bar{g}$, the policymakers' expenditure target. Intuitively, because the incentives to generate more seignorage or higher taxes are increasing in $\bar{g}$, a higher $\bar{g}$ unambiguously leads to higher incentives to generate policy surprises. On the other hand, the lower are the weights assigned by the CB on other objectives than inflation (μ_i), the higher is the optimal target. Therefore, a more inflation-averse CB works as a partial substitute for inflation targeting in achieving a low time-consistent inflation rate. The opposite holds for the FA's preferences: under our assumption that $\delta_i > \mu_i$, the optimal inflation target is increasing in both δ_1 and δ_2. A higher relative weight assigned by the FA on objectives other than inflation means that the FA takes a higher relative share of the burden of generating higher employment and more revenues for expenditure purposes, and

[18] This is not an unreasonable assumption: if the CB is sufficiently conservative (so that μ_i is low), there is not much point to try to reduce inflation by means of institutional arrangements.

consequently the need to discipline the CB is reduced.[19] The flexible target thus optimally takes into account the effects of taxes on the inflationary pressures. Finally, the optimal target is increasing in γ (an thereby in χ, the weight assigned by the TU on its employment objective). A lower γ means that the TU prefers higher nominal wages and cares less about TU employment. By choosing a lower inflation target the FA will optimally induce the CB not to accommodate such demands, and hence the inflationary pressures can be dampened before they emerge. The optimal target therefore features an additional dimension of flexibility, in the sense that it is adjusted according to the TU's behaviour as well.

Substituting (4.4) into (4.3a,b), and rearranging, results in the following equilibrium values for inflation and taxes under inflation targeting:

$$
\begin{aligned}
&a)\, p^T = \frac{\delta_1\delta_2(\delta_1+\delta_2)(1-\gamma)}{C}((1-\gamma)\bar{g}-\gamma v^*) \\
&b)\, \tau^T = \frac{\delta_2(\delta_1(1-\gamma)+\delta_2)}{C}((1-\gamma)\bar{g}-\gamma v^*)
\end{aligned}
\tag{4.5}
$$

$$
C \equiv (\delta_1+\delta_2)\{\delta_1+\delta_2+\delta_1\delta_2(1-\gamma)\}+\delta_1\gamma\{\delta_1\gamma-2(\delta_1+\delta_2)\}
$$

Comparing these with (4.1a,b) reveals that the outcomes are not identical in general. Only in the case where one of the parameters δ_1, δ_2 or γ is set equal to zero in both (4.1) and (4.5) would inflation targeting generate the same outcome than the optimal equilibrium. The FA's equilibrium loss which follows from (4.5a,b) is given by:

$$
L^{FA,S} = (p^T)^2\left[1+\frac{\delta_2 M+\delta_1 N}{\delta_1\delta_2[(1-\gamma)(\delta_1+\delta_2)]^2}\right].
\tag{4.6}
$$

$$
\begin{aligned}
M &\equiv [\delta_2+\delta_1(1-\gamma)]^2(1-\gamma)^2 \\
N &\equiv [\delta_2(1-\gamma)+\delta_1-\delta_1\gamma(2-\gamma)]^2
\end{aligned}
$$

---

[19] The partial derivatives are given as follows: $\frac{\partial \tilde{p}}{\partial \delta_1} = \frac{\delta_2\{\delta_2-\mu_2+\mu_1(1+\delta_2)\}}{(\delta_1+\delta_2+\delta_1\delta_2)^2} > 0$, $\frac{\partial \tilde{p}}{\partial \delta_2} = \frac{\delta_1\{\delta_1-\mu_1+\mu_2(1+\delta_1)\}}{(\delta_1+\delta_2+\delta_1\delta_2)^2} > 0$. Assuming that $\delta_i > \mu_i$, the indicated signs follow.

Clearly, (4.6) is not the same as the *ex ante* optimal loss (equation 4.1c). However, inflation targeting solves the problem associated with asymmetric FA and CB preferences, as the CB's preferences are replaced by the benevolent FA's preferences in the equilibrium. But inflation targeting fails to achieve the optimal outcome because in our model there are two separate labour market distortions. On one hand, the TU's too high real wage target and too low employment target render the natural rate of employment below zero. On the other hand, the presence of the TU's employment objective means that the TU forms expectations about taxes because taxes affect the level of employment. This gives raise to the fiscal time-inconsistency problem. Obviously, inflation targeting as a single instrument is not sufficient to solve two time-inconsistency problems simultaneously.

To find out whether inflation targeting is successful in improving the overall fiscal welfare, we refer to numerical simulation. In Figure 3, the horizontal axis shows γ and the vertical axis shows the gain from inflation targeting (defined as $G^{FA,T}=L^{FA,D}-L^{FA,T}$).

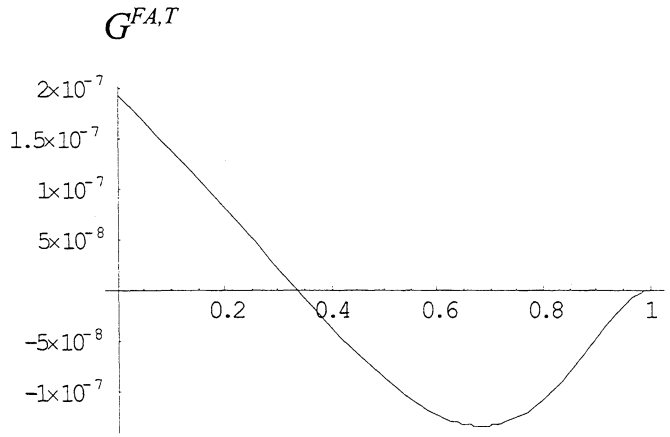

Figure 3: Trade Union Preferences and the Gain from Inflation Targeting

It can be seen, that inflation targeting maximises the FA's welfare when $\gamma = 0$, *i.e.* when χ, the TU's weight on employment, is zero. When γ increases, the TU becomes more interested in employment and the FA's own time-inconsistency problem becomes more severe. Therefore, when γ increases, the FA's overall gain from inflation targeting first decreases

in γ. In fact, the gain turns to a loss even on relatively low values of γ. However, when χ goes to infinity (so that γ approaches unity), the gain starts to increase. This happens because the distortions that are associated with the TU's real wage target get smaller when χ increases. The relationship between the TU's preferences and the gain from inflation targeting is clearly U-shaped. Therefore, inflation targeting is capable of producing the best results either when the TU is completely dominated by senior members or, alternatively, when its wage negotiating strategy totally reflects the preferences of the junior members. In a slightly different analysis, Calmfors and Driffill (1988) and Cukierman and Lippi (1998) find a U-shaped relationship between the degree of trade union *centralisation* and employment. In particular, they found that real wages are low and employment is high when the TU is either fully centralised (in which case it targets full employment) or fully decentralised (in which case there is no employment objective). If one accepts the alternative interpretation that a TU which is fully dominated by senior (junior) incentives reflects the features of a decentralised (centralised) labour market, then our model provides a generalisation of this result to the policy delegation analysis.

When compared to the outcome in Figure 1, the result in Figure 3 is clearly surprising: unlike commitments, inflation targeting generates the highest gain when the TU has no employment objective. There are two reasons. First, inflation targeting eliminates the losses that arise under commitments due to the fact that the CB's preferences are too "conservative" from the FA's point of view. The second point is more interesting and hence we prefer to study it analytically. In the extreme case where $\gamma=\chi=0$, *i.e.*, when the TU has no employment objective at all, the TU does not care about the fact that its choice of nominal wages will cause unemployment among the junior insiders. The TU then has the following loss function:

$$\frac{1}{2}(w-p-u^*)^2 \tag{4.7}$$

The TU's reaction function, and the resulting natural rate of employment, $\tilde{l}$, are now given by:

$$\begin{aligned} & w = p^e + u^* \\ & \Rightarrow \tilde{l} = -\tau - u^* < 0 \end{aligned} \tag{4.8}$$

Using (4.1), the *ex ante* optimal outcome now becomes:

$$
\begin{aligned}
&a)\, p^{OPT}\big|_{\chi=0} = \frac{\delta_1\delta_2}{\delta_1+\delta_2+\delta_1\delta_2}(\bar{g}+u^*) \\
&b)\, \tau^{OPT}\big|_{\chi=0} = \frac{\delta_2}{\delta_1+\delta_2+\delta_1\delta_2}(\bar{g}+u^*) \\
&c)\, L^{FA,OPT}\big|_{\chi=0} = (p^{OPT}\big|_{\chi=0})^2\left[1+\frac{\delta_1+\delta_2}{\delta_1\delta_2}\right]
\end{aligned}
\tag{4.9}
$$

Following the steps which lead to the inflation targeting equilibrium above, we obtain the following outcomes for the control variables inflation and taxes, for a given $\hat{p}$:

$$
\begin{aligned}
&a)\, p^T = \hat{p} + \frac{\mu_1\delta_2+\delta_1\mu_2}{\delta_2+\delta_1(1+\mu_2)+\mu_1\delta_2}[\bar{g}-\hat{p}+u^*] \\
&b)\, \tau^T = \frac{\delta_2}{\delta_2+\delta_1(1+\mu_2)+\mu_1\delta_2}[\bar{g}-\hat{p}+u^*]
\end{aligned}
\tag{4.10}
$$

To find the optimal $\hat{p}$, we again substitute the equilibrium outcomes which result from (4.10a,b) into the FA's loss function (2.4a) where $\hat{p}$ does *not* enter directly. Minimising this function with respect to $\hat{p}$, and rearranging, gives:

$$
\begin{aligned}
&\hat{p} = -\frac{\delta_1\mu_2-\delta_2(\delta_1-\mu_1)}{\delta_1+\delta_2+\delta_1\delta_2}[\bar{g}+u^*] \\
&\frac{\partial\hat{p}}{\partial u^*} < 0
\end{aligned}
\tag{4.11}
$$

The optimal target is decreasing in u^*, the TU's real wage target. Intuitively, because the natural rate of employment is decreasing in u^*, a higher u^* leads to higher incentives to generate inflation surprises. Therefore, more strict penalties are required to deter the CB from deviating from the targeted equilibrium. In order to find the equilibrium values for inflation and taxes under inflation targeting, we substitute (4.11) into (4.10a,b). After rearranging, we achieve the following outcomes:

$$(4.12)\qquad a)\,p^T = \frac{\delta_1\delta_2}{\delta_1+\delta_2+\delta_1\delta_2}(\bar{g}+u^*)$$
$$b)\,\tau^T = \frac{\delta_2}{\delta_1+\delta_2+\delta_1\delta_2}(\bar{g}+u^*)$$

Comparing these with (4.9a,b) clearly reveals that the two are identical. Therefore, when the TU has no private employment objective, the equilibrium inflation and tax rates under inflation targeting coincide with the *ex ante* optimal outcome. Moreover, because the equilibrium levels of employment and government expenditures are determined by the equilibrium rates of inflation and taxes only, the resulting equilibrium welfare losses also coincide with the *ex ante* optimal outcome (4.9c). The reason is simple: when the TU does not need to trade off real wages to insider employment, its choice of nominal wages is made conditional on expectations about inflation only. Consequently, the fiscal time-inconsistency problem does not arise, and inflation targeting is sufficient to generate the FA's optimal outcome. We have therefore shown that the presence of fiscal policy *per se* does not prevent the FA from achieving its optimal outcome by designing an inflation target to the CB.[20] However, in our model the underlying labour market structure plays a significant role as a determinant of the success of the inflation targeting regime. In particular, when the TU has an employment objective, the losses from the FA's time-inconsistency problem can be eliminated under commitments but not under inflation targeting. Therefore, the outcomes in Figures 1 and 3 show very different results.

5 Conclusion

This paper analysed monetary policy delegation in a model where fiscal policy is explicitly included. An additional novelty in our model was that we assumed a labour market structure where wage setting is characterised both by an insider-outsider problem and distortions that arise from the practice of layoffs in inverse seniority. The latter assumption implies that if the median voter of the trade union is a senior member who faces a lower risk of getting unemployed than the junior

[20] This result is in contrast to Huang and Padilla (1995), who argued that inflation targeting always leads to a sub-optimal equilibrium.

members, the trade union's optimal choice of nominal wages is too high to guarantee full employment even for the insiders. Moreover, because the trade unions face a tradeoff between real wages and employment, both fiscal and monetary policy will be subject to time-inconsistency problems in the model.

The main results were as follows. Under endogenous fiscal policy, the optimal choice of CB preferences by the FA results in an appointment of a CB who is more conservative than the FA itself, but not overly conservative. The optimal degree of CB conservativeness reflects the FA's tradeoff between lower inflation and higher employment and government expenditures. The result therefore generalises the Rogoff (1985) solution to an entirely non-stochastic framework. If the fiscal authority can subject the central bank to inflation targeting, the optimal inflation target turns out to be flexible in the sense that it is adjusted both according to the fiscal authority's and the trade union's preferences. We find that there exists a U-shaped relationship between the gain from inflation targeting and the weight the TU assigns on its employment objective relative to its real wage objective. More specifically, if the TU's preferences generate a fiscal time-inconsistency problem, inflation targeting cannot induce the FA's optimal outcome. Only if the TU is solely interested in maximising the wage bill, the fiscal time-inconsistency problem does not arise and inflation targeting successfully implements the FA's targeted equilibrium. Therefore, the interaction between fiscal and monetary policy *per se* does not prevent the fiscal authority from achieving the optimal outcome, whereas multiplicity in the TU objectives may render the equilibrium sub-optimal.

Our results clearly indicate that allowing for more realistic assumptions about the labour market structure and the role of fiscal policy in the equilibrium makes the optimal design of monetary institutions more complicated than it has been suggested so far. This illustrates how important it is that the interaction between the different authorities, as well as the functioning of the labour market, is well understood before any institutional reforms can be successfully implemented.

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