

## **CREDIBILITY AND MACROECONOMIC POLICY DESIGN: HOW EFFECTIVE ARE CURRENCY PEGS?**

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### I. INTRODUCTION

The choice of optimal monetary policy regime has been an intensely debated topic since the seminal work of Kydland and Prescott (1977) on the time inconsistency of optimal policies and the resulting inflation bias in market economies. Among the proposed solutions to alleviate/eliminate this inflation bias, the adoption of formal policy rules, delegation of monetary policymaking to independent central banks and fixing the exchange rate have played a particularly prominent role (see, Persson and Tabellini, 1994 for an overview of the early literature). A less obvious policy measure was put forward by the public debt management literature during the 1980s. It was argued that indexing the public debt to the domestic price level would act as a successful anti-inflationary policy tool (see, for example, Calvo, 1988; Bohn, 1988). Indexation of debt removes the temptation to erode the real value of government's obligations through unexpected inflation, thus eliminating an important source of inflationary bias.

The impact of this debate on policy has been reflected most obviously in the widespread move towards central bank independence by industrial and to a lesser extent developing countries. Despite the adoption of a single currency in Europe (which was not motivated primarily by inflation concerns), the trend has been towards more rather than less flexible

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exchange rate regimes.<sup>1</sup> Although more industrial countries now issue indexed debt, they still mostly issue nominal debt denominated in their own currency (see, for example, Falcetti and Missale, 2004 for developed country experiences and Turner, 2007, and Borensztein et al. 2004 for recent developments in emerging market countries). One possible reason for this is that, if inflation is addressed effectively by an independent central bank, exchange rate and debt policies can be targeted at other objectives, such as the absorption of shocks (Broda, 2004; Falcetti and Missale, 2004). Nevertheless there are still many countries in the world (e.g. in Africa) where monetary policy is essentially subordinated to fiscal policy, and other instruments may be needed to stabilize prices. Addressing these issues is the main purpose of this paper.

We utilize a standard fiscal and monetary policy model in which the government cares about price stability, output and government expenditure. Taxes are distortionary and reduce output, which creates a trade-off between the last two objectives. Substituting seigniorage revenue for taxation relaxes this constraint, but at the expense of sacrificing the first objective. We provide a comparative analysis of central bank independence, exchange rate pegs and indexation of public debt as potential devices to enhance the credibility of monetary policy.<sup>2</sup>

Our analysis provides a set of interesting results. First we show that, in a non-stochastic one-period setting, there is a clear ranking of inflationary outcomes: exchange rate pegs are the most effective anti-inflationary measures and provide the lowest inflation. Given the absence of

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<sup>1</sup> See, Fischer (2001), for an analysis of recent trends in the choice of exchange rate regimes in both the emerging market and industrialized countries

<sup>2</sup> The paper that is closest to ours is Falcetti and Missale (2004), who explored the interactions between public debt management and central bank independence. We extend their analysis in two ways: by considering exchange rate pegs, and by endogenizing government spending. Falcetti and Missale (2004) focused on the link between public debt instruments and central bank independence and thus on optimal delegation. We provide a comparative analysis of all three regimes for both nominal (inflation) and real variables (output and public spending), in the context of different weights in the government's objective function.

seigniorage revenues when inflation is eliminated under exchange rate pegs, policymakers need to resort to the highest level of distortionary taxes. As a result, exchange rate pegs yield the greatest deviations of output and public spending from target. At the other extreme, our benchmark case of centralized policymaking with nominal debt is the most inflationary, but the best in terms of other objectives. Overall, which regime dominates clearly depends on the government's relative concern for nominal (inflation) versus real (output and public spending) deviations from target. The greater the aversion to nominal deviations, the greater the benefit of the best inflation performers such as independent central banks and exchange rate pegs. Our sensitivity analysis also suggests that delegation of monetary policymaking to independent central banks is the preferred policy regime for a wide range of parameter values and is in line with the dramatic change in practice regarding central banking institutions over the last two decades (Cukierman, 2007). Our model also explains why countries characterized by fiscal dominance (a high weight on the fiscal objective) are more reluctant to embrace central bank independence.

The rest of this paper is organized as follows. Section II sets out the basic model. Section III provides the characterization of equilibrium under all four policy regimes; centralized policymaking with nominal and indexed debt, delegation of monetary policy to an independent central bank and an exchange rate peg and presents a ranking of outcomes. Finally, concluding remarks are presented in Section IV.

## II. THE BASIC MODEL

We utilize a simple model of discretionary monetary and fiscal policy, in which the government dislikes deviations of inflation, output and public spending from target, and tax distortions depress output.<sup>3</sup>

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<sup>3</sup> Similar variants of this model are used by Beetsma and Bovenberg (1997, 1999) and Ozkan (2000).

The government's disutility function can be represented in the following form:

$$L_t^G = \frac{1}{2} \sum_{t=1}^T \beta_G^{t-1} \left[ \delta_1 \pi_t^2 + (x_t - \dot{x}_t)^2 + \delta_2 (g_t - \dot{g}_t)^2 \right] \quad (1)$$

where  $L_t^G$  denotes the welfare losses incurred by the government;  $\delta_1$  and  $\delta_2$  represent, respectively, the government's relative dislikes for the deviations of inflation ( $\pi_t$ ) and public spending as a share of output ( $g_t$ ) from their target levels (0 and  $\dot{g}_t$ , respectively) relative to the deviations of (log of) output ( $x_t$ ) from its target level ( $\dot{x}_t$ ); and  $\beta_G$  is the government's discount factor. The target level of inflation is taken to be zero to indicate the desirability of price stability. A non-zero output target ( $\dot{x}_t$ ) represents the bliss point for output the absence of non-tax distortions such as labour or commodity market imperfections. The bliss point for public spending ( $\dot{g}_t$ ) can be interpreted as the optimal share of non-distortionary output to be spent on public spending. Both weights  $\delta_1$  and  $\delta_2$  and the bliss points for output and public spending ( $\dot{x}_t$  and  $\dot{g}_t$ ) reflect the political and the institutional structure of the economy.

Similarly, the preferences of the central bank are summarized by

$$L_t^{CB} = \frac{1}{2} \sum_{t=1}^T \beta_{CB}^{t-1} \left[ \mu_1 (\pi_t - \dot{\pi}_t)^2 + (x_t - \dot{x}_t)^2 \right] \quad (2)$$

where  $L_t^{CB}$  denotes the welfare losses incurred by the central bank at period  $t$ ,  $\beta_{CB}$  is the central bank's discount factor and  $\mu_1$  is used for the central bank's inflation aversion parameter. In contrast to the government, the independent central bank cares only about deviations of inflation and output from their targets, and attaches no value to attaining the government's expenditure objective. Moreover, the

independent central bank is more inflation averse than the government,  $\mu_1 > \delta_1$ .

Output is given by the following production function:  $Y_t = N_t^\gamma$ , where  $Y_t$  and  $N_t$  represent output and labour respectively, in period  $t$ , and  $0 < \gamma < 1$ . Distortionary taxes, which are the only form of taxes available to the government, are levied on output at the rate  $\tau_t$ . A representative competitive firm's problem is to maximize profits  $P_t(1 - \tau_t)N_t^\gamma - W_tN_t$ , where  $P_t$  and  $W_t$  represent the price level and the wage rate respectively, in period  $t$ . A representative competitive firm chooses labour to maximize profits by taking  $P_t$ ,  $W_t$  and  $\tau_t$  as given. The resulting output supply function is  $y_t = \alpha(p_t - w_t - \tau_t) + z$ , where lower case letters represent logs, e.g.  $y_t = \ln(Y_t)$ ,  $\alpha = \gamma / (1 - \gamma)$ ,  $z = \alpha \ln(\gamma)$  and  $\ln(1 - \tau) \simeq -\tau$ . Normalizing output by subtracting  $z$  from  $y_t$  for simplicity, and utilizing  $w_t = p_t^e$ , yields the following normalized output supply function

$$x_t = \alpha(\pi_t - \pi_t^e - \tau_t) \quad (3)$$

where  $\pi_t^e$  is expected inflation and all other variables are as defined above.

The government budget constraint creates the link between the fiscal and monetary policies chosen by the government and the central bank. This constraint is formally given by:

$$g_t + (1 + r)d_{t-1} = \tau_t + k\pi_t + d_t \quad (4)$$

where  $d_{t-1}$  is the debt issued in period  $t-1$  (as a ratio of output) that has to be paid back in period  $t$ ,  $r$  is the *ex post* real interest rate,  $d_t$  is new debt raised in the current period and  $k$  measures real money holdings as a share of output.

### III. CHARACTERIZATION OF EQUILIBRIUM

To keep the structure as simple as possible and to focus our attention on the denomination of existing debt, in what follows we exclude the possibility of new borrowing. In the absence of new debt there are no intertemporal linkages between different periods in the current framework.<sup>4</sup> Therefore, all our results can be conveniently derived using a one-period setting.

The government budget constraint described in equation (4) then takes the following form

$$g + (1 + r)d_o = \tau + k\pi \quad (5)$$

where  $d_o$  is the outstanding debt obligations. All time subscripts are dropped for notational simplicity given the one-period nature of the set-up.

Equation (5) indicates that the policymaker can resort to a combination of taxes and seigniorage to pay for current spending and the outstanding debt repayments.

We now turn to deriving the macroeconomic outcome under a number of policy arrangements.

#### *Centralized Policymaking with Nominal Debt*

Our benchmark case is centralized policymaking when all public debt is in nominal terms. The government chooses both fiscal and monetary policy instruments (the central bank is not independent of the political authority).

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<sup>4</sup> This is because there are no other links between different periods in this setting. Ismihan and Özkan (2004 and 2005) developed an extended version of this model where public spending has long-term output effects, introducing a second intertemporal link between periods in addition to borrowing.

With nominal debt, the government budget constraint takes the following form:

$$g + \left(1 + \rho - (\pi - \pi^e)\right) d_o = \tau + k\pi \quad (6)$$

where  $\rho$  is the *ex ante* real interest rate. Equation (6) indicates that, in the presence of nominal debt, surprise inflation erodes the real value of government debt.

The government's optimization problem is to choose  $\pi$ ,  $\tau$  and  $g$  to minimize its welfare losses subject to the budget constraint, which can be set out as the following

$$L = \frac{1}{2} \left[ \delta_1 \pi^2 + (x_t - \dot{x})^2 + \delta_2 (g - \dot{g}) \right] + \lambda \left[ g - \tau - k\pi + \left(1 + \rho - (\pi - \pi^e)\right) d_o \right] \quad (7)$$

where  $\lambda$  is the Lagrangian multiplier associated with the government budget constraint.

Substituting (3) into (7), differentiating with respect to the choice variables, eliminating  $\lambda$  from the above system and imposing rational expectations,  $\pi = \pi^e$ , yield the following reaction functions:

$$\pi = \frac{\alpha^2}{\delta_1} \left[ \tau + \frac{\dot{x}}{\alpha} \right] \quad (8)$$

$$\dot{g} - g = \frac{\alpha^2}{\delta_2} \left[ \tau + \frac{\dot{x}}{\alpha} \right] \quad (9)$$

Substituting (8) and (9) into the relevant first order conditions and rearranging yields the following equilibrium value of  $\pi$ .

$$\pi_n = \frac{(1 + k + d_o)}{\delta_1 D} \left[ \dot{K} + (1 + \rho) d_o \right] \quad (10)$$

where subscript  $N$  is used to indicate outcomes when all debt is in nominal terms (in domestic currency) and  $D = \left( \frac{1}{\alpha^2} + \frac{k(1+k+d_o)}{\delta_1} + \frac{1}{\delta_2} \right)$

Equation (10) reveals that non-zero inflation has two sources; structural distortions in the economy,  $\dot{K} = \dot{g} + \dot{x} / \alpha$ , and the debt burden,  $(1+\rho)d_o$ . The extent to which these two sources raise inflation is determined by the policymakers' preferences,  $\delta_1$  and  $\delta_2$ , as well as structural parameters such as  $\alpha$  and  $k$ .

Given (10), it is straightforward to solve for output and public spending gaps (deviations of output and public spending from their target levels), which are given by

$$(\dot{x} - x)_N = \frac{[\dot{K} + (1 + \rho)d_o]}{\alpha D} \tag{11}$$

$$(\dot{g} - g)_N = \frac{[\dot{K} + (1 + \rho)d_o]}{\delta_2 D} \tag{12}$$

Inspecting (11) and (12) indicates that the slope of the Phillips curve ( $\alpha$ ) and the policymaker's degree of dislike for public spending deviations ( $\delta_2$ ) determine the relative sizes of output and public spending gaps. The more effective an inflation surprise is in expanding output,  $\alpha$ , the smaller the gap between the actual and target levels of output. And the higher the policymaker's dislike for public spending deviations,  $\delta_2$ , the smaller the gap between the equilibrium and target levels of public spending.

Substituting (10) — (12) into (1) yields the following welfare losses under centralized policy regime with nominal debt:

$$L_N^G = \frac{1}{D^2} [\dot{K} + (1 + \rho)d_o]^2 F \tag{13}$$

where 
$$F = \left( \frac{1}{\alpha^2} + \frac{(1+k+d_o)^2}{\delta_1} + \frac{1}{\delta_2} \right).$$

*Centralized Policymaking with Indexed Debt*

Price indexation of government debt has been put forward as a potential anti-inflationary policy tool (see, for example, Guidotti, 1992; Calvo and Guidotti, 1990; and Bohn, 1988). Clearly, when debt is indexed to the domestic price level the policymaker can no longer reduce the real value of the debt by surprise inflation. Then the government budget constraint simplifies to

$$g + (1 + \rho)d_o = \tau + k\pi \tag{14}$$

where *anteex* and *ex post* real interest rates are the same.

Repeating the same procedure as above yields the following equilibrium value of  $\pi$  with indexed debt.

$$\pi_1 = \frac{(1+k)}{\delta_1 D^*} \left[ \overset{\circ}{K} + (1 + \rho)d_o \right] \tag{15}$$

where subscript *l* is used for indexed debt and  $D^* = \left( \frac{1}{\alpha^2} + \frac{k(1+k)}{\delta_1} + \frac{1}{\delta_2} \right)$

– Result 1: Issuing indexed debt is an effective way of enhancing the credibility of anti-inflationary policy and produces a lower inflation outcome than with nominal debt.

– Proof: Comparing (15) with (10) suggests that  $\pi_N > \pi_l$  for all values of  $d_o > 0$ .

Similarly, output and public spending gaps with indexed debt are given by

$$(\dot{x} - x)_I = \frac{[\dot{K} + (1 + \rho)d_o]}{\alpha D^*} \quad (16)$$

$$(\dot{g} - g)_I = \frac{[\dot{K} + (1 + \rho)d_o]}{\delta_2 D^*} \quad (17)$$

– Result 2: A change from fully nominal to fully indexed debt raises the deviations of both output and public spending from their targets.

– Proof: Comparing (16) and (11) and (17) and (12) indicates that  $(\dot{x} - x)_I > (\dot{x} - x)_N$  and  $(\dot{g} - g)_I > (\dot{g} - g)_N$  given that  $D > D^*$  for all values of  $d_o > 0$ .

Substituting the equilibrium values of  $\pi$ ,  $(\dot{x} - x)$  and  $(\dot{g} - g)$  from (15)–(17) into the government's loss function in equation (1) yields

$$L_I^G = \frac{1}{D^{*2}} [\dot{K} + (1 + \rho)d_o]^2 F^* \quad (18)$$

where  $L_I^G$  indicates welfare losses under the centralized outcome with indexed debt and  $F^* = \left( \frac{1}{\alpha^2} + \frac{(1+k)^2}{\delta_1} + \frac{1}{\delta_2} \right)$ .

### Central Bank Independence

One of the most influential policy implications from the literature on optimal monetary policy design has been related to the central bank independence. Following the influential work of Rogoff (1985), it has been widely argued that central bank independence presents a 'free lunch' achieving low inflation at no real cost (see, for example,

Alesina and Gatti, 1995).<sup>5</sup> Indeed a large number of countries in both the industrialized and the developing world have granted independence to their central banks since the early 1990s.<sup>6</sup>

This section explores the implications of delegating monetary policy to an independent central bank within the framework of the model set out earlier. In this case inflation is the instrument of an independent central bank whose preferences represented by equation (2), while the fiscal authority chooses the tax rate and public spending.

Given that monetary policy decisions are made by an independent central bank, inflation will be chosen to minimize the central bank's welfare losses as given by

$$L^{CB} = \left[ \mu_1 (\pi_t - \dot{\pi})^2 + (x_t - \dot{x})^2 \right] \quad (19)$$

while taxes and public spending will be chosen to minimize

$$L^G = \frac{1}{2} \left[ \delta_1 \pi^2 + (x_t - \dot{x})^2 + \delta_2 (g - \dot{g})^2 \right] \quad (20)$$

Repeating the same procedure as above yields the following outcome when monetary and fiscal policy decisions are taken in a decentralized fashion,

$$\pi_{CBI} = \frac{\left[ \dot{K} + (1 + \rho)d_o \right]}{\mu_1 C} \quad (21)$$

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<sup>5</sup> There is supporting evidence at least from the developed country experiences that central bank independence produces lower inflation (see, for example, Alesina and Summers, 1993). The evidence for developing countries is mixed however, as indicated by Cukierman (1994). Ismihan and Ozkan (2004) provides one explanation why this may be the case.

<sup>6</sup> See, Cukierman (2007) for a comprehensive review of the changes in central banking institutions over the last two decades.

where subscript CBI is used to indicate outcomes with an independent central bank and  $C = \left( \frac{1}{\alpha^2} + \frac{k}{\mu_1} + \frac{1}{\delta_2} \right)$ . It is important to note that whether

the debt is nominal or indexed is irrelevant for the outcomes when monetary policy decisions are taken by an independent central bank. This is because the independent central bank does not internalize the government budget constraint and attaches no value to deviations of government expenditure from the target.

– Result 3: Delegating monetary policymaking powers to an independent central bank unambiguously lowers inflation. This is the case even if the government is able to index all government debt.

– Proof: Comparing (21) with (10) suggests that for  $\pi_{CBI} < \pi_N$  to hold the following inequality should hold,  $\delta_1 / \mu_1 < (1 + k + d_O)$ . This, in turn, unambiguously holds since  $\delta_1 / \mu_1 < 1$ , the central bank is the more conservative of the two authorities. Similarly, comparing (21) with (15) shows that  $\pi_{CBI} < \pi_I$  requires  $\delta_1 / \mu_1 < (1 + k)$ , which again holds for all parameter values given that  $k \geq 0$ .

Similarly, output and public spending gaps are given by

$$(\dot{x} - x)_{CBI} = \frac{[\dot{K} + (1 + \rho)d_O]}{\alpha C} \quad (22)$$

$$(\dot{g} - g)_{CBI} = \frac{[\dot{K} + (1 + \rho)d_O]}{\delta_2 C} \quad (23)$$

– Result 4: Central bank independence yields the greatest deviations of output and public spending from their target levels as compared with centralized policymaking with both nominal and indexed debt.

– Proof: Expressions in equations (22), (16) and (11) can be ranked as  $(\dot{x} - x)_{CBI} > (\dot{x} - x)_I > (\dot{x} - x)_N$  given that  $D > D^* > C$ . This also establishes that  $(\dot{g} - g)_{CBI} > (\dot{g} - g)_I > (\dot{g} - g)_N$ .

Substituting (21)–(23) into (1) suggests that the welfare losses of the government when monetary policy is made by an independent central bank is given by

$$L_{CBI}^G = \frac{1}{C^2} \left[ \dot{K} + (1 + \rho)d_o \right]^2 C^* \quad (24)$$

where  $C^* = \left( \frac{1}{\alpha^2} + \frac{\delta_1}{\mu_1^2} + \frac{1}{\delta_2} \right)$ .

#### *Fixed Exchange Rate Regime*

The defining feature of a fixed exchange rate regime is the ability to anchor monetary policy to that of another country which does not have the same credibility problems. Setting the rate of foreign price level changes at zero for simplicity, it follows that under a fixed exchange rate regime domestic inflation will also be zero:

$$\pi_P = \pi^* = 0 \quad (25)$$

where  $\pi^*$  indicates foreign inflation and subscript  $P$  is used for outcomes under a currency peg.

– Result 5: A currency peg is the most effective anti-inflationary device of all three regimes in a deterministic setting and produces the lowest inflation in equilibrium.

– Proof: This result follows from comparing (25) with equilibrium inflation under *CBI* in (21), with indexed and nominal debt in (15) and (10), respectively.

Utilizing (25) and solving for the government's loss minimization problem as above yields the following output and public spending gaps in equilibrium

$$(\dot{x} - x)_P = \frac{[\dot{K} + (1 + \rho)d_o]}{\alpha P} \quad (26)$$

$$(\dot{g} - g)_P = \frac{[\dot{K} + (1 + \rho)d_o]}{\delta_2 P} \quad (27)$$

where  $P = \left( \frac{1}{\alpha^2} + \frac{1}{\delta_2} \right)$ .

As is the case with the independent central bank, under pegging equilibrium outcomes do not vary with debt denomination. This is because the exchange rate peg is taken to be fully credible and thus expected and actual inflation outcomes coincide,  $\pi = \pi^e$ .

– Result 6: Currency pegs produce the highest deviations of output and public spending from their target levels among all four regimes.

– Proof: This follows from the ranking  $D > D^* > C > P$ .

The resulting welfare loss is, in turn, given by

$$L_P^G = \frac{1}{P} [\dot{K} + (1 + \rho)d_o]^2 \quad (28)$$

### *Sensitivity Analysis*

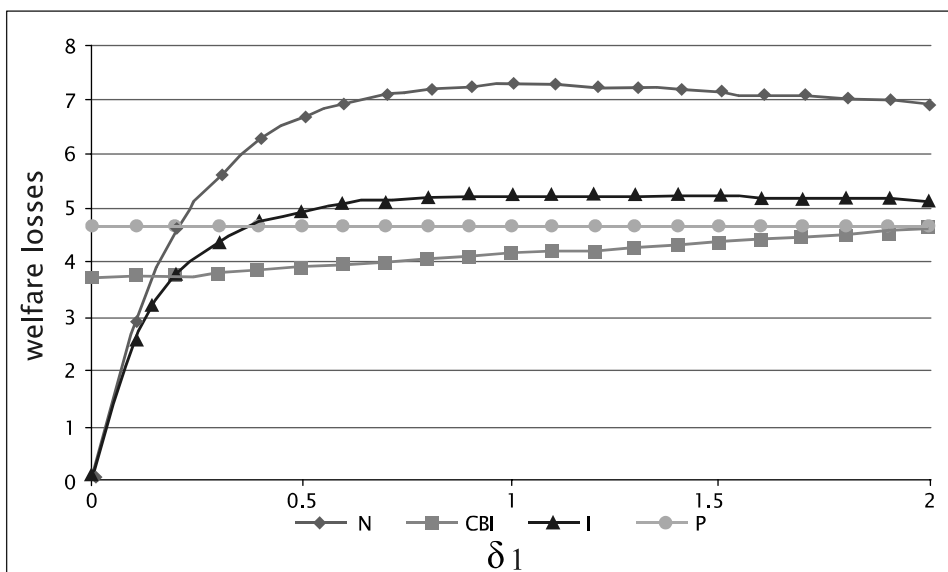
The previous section presented macroeconomic outcomes under three separate policymaking regimes: (a) centralization, where both fiscal and monetary policies are made by the government; (b) delegation of monetary policy to an independent central bank; and (c) an exchange

rate peg. Centralized outcomes are reported with both nominal and indexed debt. Formal results presented above aimed at evaluating the effectiveness of alternative monetary policy regimes in mitigating credibility problems. In doing that, equilibrium outcomes are ranked under the three monetary policymaking regimes.

In order to rank one type of policy regime relative to another, it is necessary to provide an overall welfare analysis based on the policymaker's welfare loss functions. These are also listed in the previous section. This section provides a sensitivity analysis exploring the response of welfare losses to changes in a number of parameters. These are plotted in Figures 1–4 (The numerical solution underlying Figures 1–4 is based on the following baseline parameter set;  $\alpha = 1$ ,  $d_0 = 1$ ,  $\dot{X} = 1$ ,  $\dot{g} = 1$ ,  $\rho = 0.05$ ,  $\mu_1 = 2$ ,  $\delta_1 = 1$ ,  $\delta_2 = 1$  and  $k = 0.5$ . Also, as in the text, *N*, *I*, *CBI* and *P* refer to centralized regime with nominal and indexed debt, central bank independence and exchange rate pegging, respectively). We view the centralized policy regime with nominal debt as the benchmark case, and debt indexation, central bank independence and exchange rate pegging as alternative ways of enhancing the monetary policy credibility of the government. With respect to inflation performance, the formal results in the previous section indicated a clear ranking: the exchange rate peg is shown to improve most upon the benchmark outcome, which is followed by the independent central bank, which, in turn, produces lower inflation than under debt indexation. On the other hand, the ranking of real variables (output and public spending) is shown to produce the opposite result. That is, an exchange rate peg, which performs best on inflation, yields the greatest deviations, while centralized policymaking with nominal debt, which has the highest inflation, produces the lowest deviations of output and public spending from their target levels. It, therefore, follows that which regime is best overall will be determined by the policymaker's aversion parameters for inflation, output and public spending deviations from their target levels.

Figure 1 plots the welfare losses to the government under the benchmark case and the three alternative policy regimes as a function of the government's inflation aversion,  $\delta_I$ . Clearly, when  $\delta_I=0$ , where the policymaker cares infinitely more about output deviations, the exchange rate peg is the worst performing regime, with highest welfare losses, and central bank independence provides the second worst outcome. As the inflation aversion parameter rises towards one, where the policymaker is equally concerned about inflation and output deviations from targets, the benchmark case becomes the worst-case scenario with indexed debt the second worst. The best inflation performer (the exchange rate peg) is dominated by central bank independence, because the loss of seigniorage revenues with zero inflation under the peg needs to be compensated by distortionary taxation, with undesirable consequences.

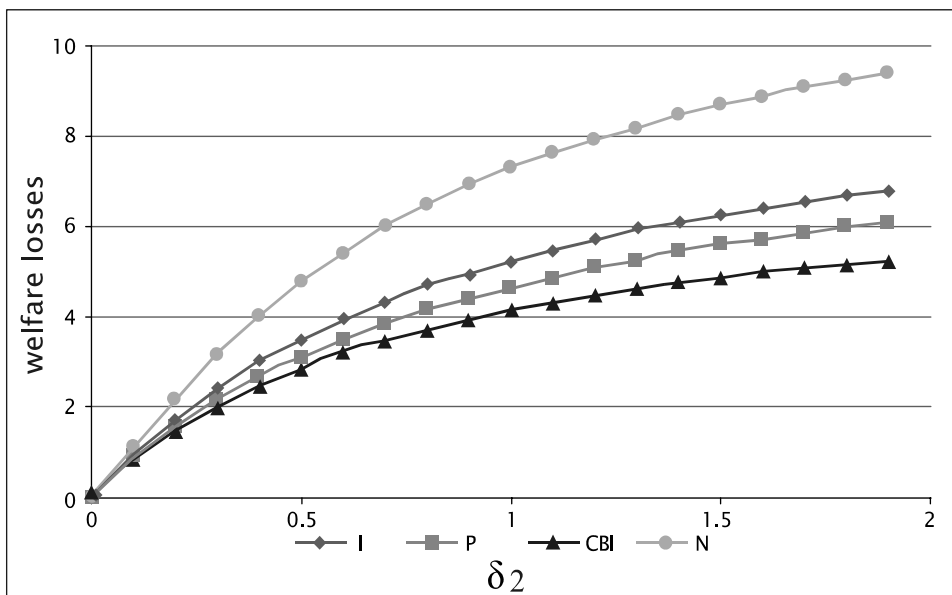
Figure 1



This is also the case with low inflation under central bank independence though to a smaller extent.<sup>7</sup>

Figure 2 plots the government's welfare losses under the four regimes as a function of the policymaker's dislike for public spending deviations when inflation and output deviations have equal weight. A clear ranking is apparent, in that losses are highest under the benchmark case of centralized policymaking with nominal debt, followed by indexed debt, a currency peg and central bank independence. Note also that, the greater the dislike of authorities for public spending deviations, the greater is the difference between the benchmark case and the other three regimes and thus the effectiveness of all three credibility enhancing measures.

**Figure 2**



<sup>7</sup> It is straightforward to show that equilibrium tax rate under the four regimes is given by  $\tau_i = \frac{[\dot{K} + (1 + \rho)d_o]}{\alpha^2 D^*} - \frac{\dot{x}}{\alpha}$  where  $i$  indicates the policy regime and  $D^*$  is given by  $D$

for centralized regime with nominal debt,  $D^*$  for centralized regime with indexed debt,  $C$  for central bank independence and  $P$  for the exchange rate peg and all  $D$ ,  $D^*$ ,  $C$  and  $P$  are as defined in the text. Given the ranking  $D > D^* > C > P$ , it follows that

$$\tau_N < \tau_I < \tau_{CBI} < \tau_P .$$

Does the weight on public spending make a difference when the government's inflation aversion is relatively weak (0.2), so that central bank independence is not necessarily optimal? Figure 3 shows that it does. Central bank independence is only optimal at relatively low levels of  $\delta_2$  (less than one). Above that, debt indexation is preferred. In other words, the level of inflation aversion above which central bank independence is preferred increases with the weight on public spending. This reflects the fact that seigniorage revenue becomes more important, the more intent the government is on reaching its spending target.

Figure 3

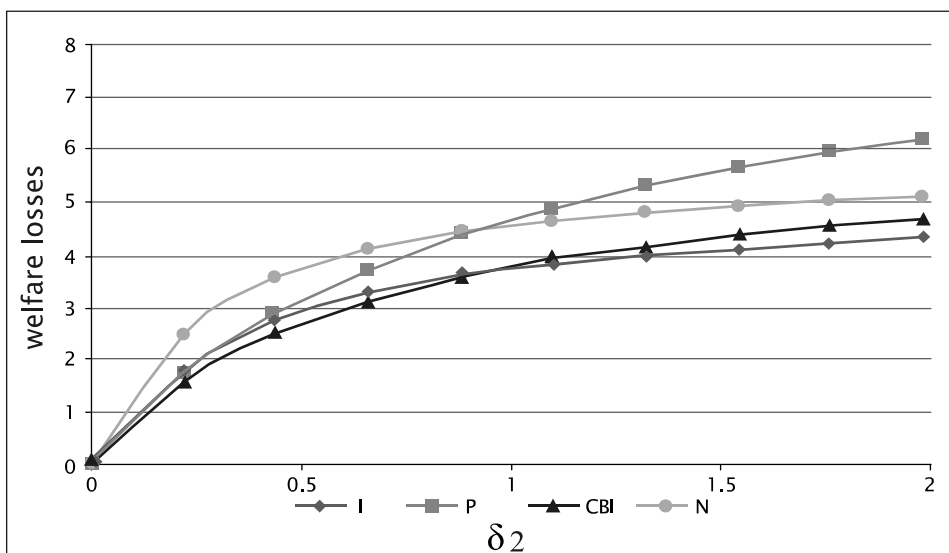
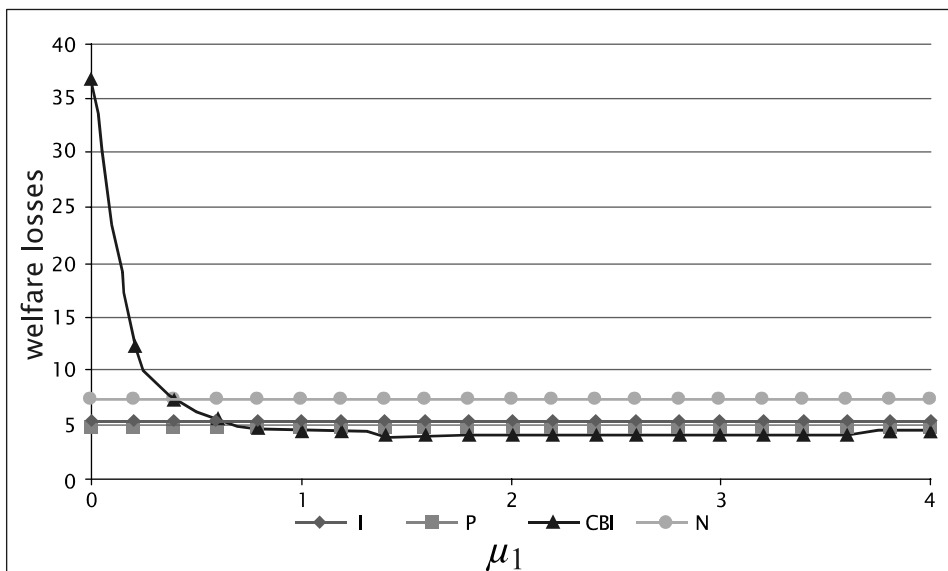


Figure 4 presents the welfare losses as a function of the central bank's conservativeness and highlights the well-known benefits of conservative central bankers. For  $\mu > 1$ , which indicates the range over which the central bank is more conservative than the government (note that  $\delta_1 = 1$ ), an independent central bank produces the lowest welfare losses of all four regimes. As  $\mu$  falls below one, the opposite is the case.<sup>8</sup>

<sup>8</sup> Note that this is the case in the absence of stochastic elements. In the presence of shocks, too high a degree of conservativeness has the additional disadvantage of increasing the variability of the economy's response to these shocks (Rogoff, 1988; Svensson, 1999).

**Figure 4**



#### IV. CONCLUSIONS

We have presented an analysis of optimal regime choice using a model in which governments dislike inflation and the deviation of output and government expenditure from target. The model has an inflation bias because the tax required to finance government expenditure is distortionary and depresses output, and because inflation also yields seigniorage revenue. Moreover, there is an extra incentive to create unanticipated inflation in the presence of nominal debt. There are various ways of addressing this inflation bias: yielding control over monetary policy to an independent central bank that does not care about expenditure targets and is more averse to inflation than the government; pegging the exchange rate; and indexing debt to the price level.

We have examined the equilibrium solution to this model under these various alternatives. Exchange rate pegs produce the lowest inflation, followed by central bank independence, but with the highest deviations of output and government expenditure from target, again followed by central bank independence. Consequently, the ranking of these

alternative mechanisms depends on the government's preferences. Unless the government's aversion to inflation is low, central bank independence or an exchange rate peg tends to be superior to the indexation of debt, because the inflation benefits outweigh the losses in the other dimensions. In fact, a currency peg is always inferior to central bank independence. The term "fiscal dominance" is often used rather loosely to mean that monetary policy has to adjust to fiscal shocks. In the context of this model, a high weight on the government expenditure target only makes a difference to the optimal choice for certain values of the inflation aversion parameter. Within a certain range, however, there is an important interaction between the two, where a high weight on the government expenditure target makes debt indexation preferable to central bank independence, and vice versa for a low weight. In this sense, the model predicts that fiscal dominance will be associated with a dependent central bank only if the government has a relatively weak attachment to price stability as well as a strong attachment to its expenditure targets.

These conclusions have been derived in a model without stochastic shocks. One obvious way to extend this analysis would be to consider optimal regime choice in the presence of shocks. In that case, the shock-absorbing properties of different regimes would have a significant impact on determining which regime delivers the best results.

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