GOVERNMENT LEADERSHIP AND CENTRAL BANK DESIGN

by

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Abstract

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This article investigates the impact on economic performance of the timing of moves in a policy game between the government and the central bank for a government with both distributional and stabilization objectives. It is shown that both inflation and income inequality are reduced without sacrificing output growth if the government assumes a leadership role compared to a regime in which monetary and fiscal policy is determined simultaneously. Further, it is shown that government leadership benefits both the fiscal and monetary authorities. The implications of these results for a country deciding whether to join a monetary union are also considered.

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1. Introduction

Over the past ten years, many countries have undertaken significant reforms in their monetary institutions. Most of these reforms have focused on providing central banks with a clear mandate to control inflation and greater responsibility for achieving lower inflation. However, there have been few reforms of fiscal institutions and countries vary widely in the institutional arrangements they have adopted for coordinating fiscal and monetary interactions. One of the primary differences between these new monetary institutions is the degree to which the government assumes a leadership role in determining the objectives of policy. Our purpose, in this article, is to determine whether government leadership can be expected to have a positive or negative impact on economic performance.

Weymark's (2003) model of monetary policy delegation provides the theoretical framework for our analysis. In this model, the optimal institutional design, defined in terms of central bank independence and conservatism, is the outcome of a two-stage non-cooperative game between the the government and the central bank. In the first stage of the game, the government selects a suitably conservative central banker and chooses how much independence to grant the central bank. In the second stage, the central bank and the government move simultaneously; the government sets government expenditures and transfer payments and the central bank sets the size of the money supply.

This model is a better representation of the monetary institutions in some countries than in others. The strategic interaction between the European Central Bank (ECB) and the governments of EMU members, for example, is probably best approximated by a game in which the ECB and national fiscal authorities are engaged in a non-cooperative, simultaneous move game. However, the institutional arrangements that have been adopted in other countries, in particular Canada, New Zealand, and the United Kingdom, are characterized by a significant degree of fiscal leadership. Governments that can exert influence over monetary policy are likely to take this into account when formulating their fiscal policies. In order to capture this aspect of government leadership, we amend our model to allow the government to play the role of Stackelberg leader in the second stage of the policy game. We also assume that the central bank's inflation target is established by government mandate.[1] Our results show that government leadership improves inflation performance and enhances income redistribution without sacrificing output growth. These improvements therefore benefit both the monetary and fiscal authorities. Government leadership is mutually beneficial because it introduces an element of coordination between fiscal and monetary policy without requiring either authority to relinquish its freedom to make independent policy choices.

This article makes a number of contributions to the literature. First, by introducing fiscal policy into a standard model of monetary policy delegation, we are able to show how fiscal-monetary interactions can be used to improve economic performance beyond those associated with monetary delegation alone. Second, we consider fiscal policy as a means of providing public services and a measure of social equity.[2] These are long term, and frequently contractual, objectives that are not easily reversed; they have become an increasingly important part of fiscal policy in many countries.[3] We find that the long-term distributional objectives constrain the govenment's pursuit of oppportunistic or short-run stabilization objectives and, consequently, make government leadership desirable. Finally, we explicitly endogenize the choice of institutional arrangements and are therefore able to provide a rationalization for the combination of insturment independence and policy conservatism that many economies have adopted in practice.

In order to assess whether our results are of practical importance, we calculate the losses associated with the two policy regimes, simultaneous moves and government

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[1] The assumption that the central bank's inflation target is chosen by the government is maintained throughout the main text; we consider the case in which the central bank chooses its own target in Appendix 2.

[2] Here we build on the results in Hughes Hallett and Weymark (2004b), which, in turn, represents a generalization of Dixit and Lambertini's (2003) model of fiscal-monetary interactions.

[3] See HM Treasury (2003).

leadership, for nine countries: Canada, France, Germany, Italy, New Zealand, Sweden, Switzerland, the United Kingdom, and the United States. When we express our measure of welfare in output equivalent units, we find that the benefits of government leadership are equivalent to a permanent increase of 1–2 percent in the long run growth rate for all countries. This result is of particular significance in countries such as the United Kingdom, which have monetary institutions that confer leadership roles on their governments. Conversely, for countries where the government is not the policy leader, this result is important in periods of slow growth and high unemployment.

2. Economic Structure

The model used in Weymark (2003) provides a useful framework for the present analysis. For purposes of exposition, we suppress potential spillover effects between countries and focus on the following three equations to represent the economic structure of any country:

$$\pi_t = \pi_t^e + \alpha y_t + u_t \tag{1}$$

$$y_t = \beta(m_t - \pi_t) + \gamma g_t + \epsilon_t \tag{2}$$

$$g_t = m_t + s(by_t - \tau_t) \tag{3}$$

where π_t is the inflation rate in period t, y_t is output growth in period t, and π_t^e represents the rate of inflation that rational agents expect will prevail in period t, conditional on the information available at the time expectations are formed. The variables m_t, g_t, and τ_t represent, respectively, the growth in the money supply, government expenditures, and tax revenues in period t. The variables u_t and ϵ_t are random disturbances which are assumed to be independently distributed with zero mean and constant variance. The coefficients $\alpha, \beta, \gamma, s,$ and b are all positive by assumption. The assumption that γ is positive may be considered controversial.[4]

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[4] Barro (1981) argues that government purchases have a contractionary impact on output. However, in contrast to those who argue that fiscal policy has little systematic or positive impact on economic performance, our model treats fiscal policy as important because (i) fiscal policy is used by

However, short-run impact multipliers derived from Taylor's (1993) multi-country estimation provide empirical support for this assumption. [5]

According to (1), inflation is increasing in the rate of inflation predicted by private agents and in output growth. Equation (2) indicates that both monetary and fiscal policies have an impact on the output gap. The microfoundations of the aggregate supply equation (1), originally derived by Lucas (1972, 1973), are well-known. McCallum (1989) shows that aggregate demand equations like (2) can likewise be derived from a standard, multiperiod utility-maximization problem.

Equation (3) describes the government's budget constraint. For the purposes of illustration, we allow discretionary tax revenues to be used for redistributive purposes only. The government must finance discretionary expenditures by selling bonds to the central bank or the private sector. We assume that there are two types of agents, rich and poor, and that only the rich use their savings to buy government bonds. Thus, b is the proportion of pre-tax income (output) that goes to the rich and s is the proportion of after-tax income that the rich allocate to saving. Tax revenues, τ_t, are used by the government to redistribute income from rich to poor. All variables are measured as deviations from their long-run equilibrium paths, and we treat trend budget variables as balanced.

The structure we have described distinguishes between output-enhancing government expenditures g_t and government transfers τ_t. Many government expenditures have a redistributional impact becasue they benefit the poor to a greater extent than the rich. However, there are also expenditures which are undertaken for the purpose of benefiting everyone, regardless of income level; for example, health, education, or infrastructure. In thie article, we consider only two types of expenditure – re-

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governments to achieve includes redistributive objectives whose consequences need to be taken into account and (ii) as Dixit and Lambertini (2001, 2003) point out, governments cannot precommit monetary policy with any credibility if fiscal policy is not also precommitted.

[5] For example, using Taylor's empirical results, Hughes Hallett and Weymark (2004c) obtain short-run γ estimates of 0.57, 0.43, 0.60, and 0.58 for France , Germany, Italy, and the United Kingdom, respectively.

distributional expenditures (τ_t) and output-enhancing expenditures (g_t). Both are financed by aggregate tax revenues, i.e., by discretionary plus trend tax revenues. Any expenditure in excess those revenues must be financed by the sale of bonds.

Using (1) and (2) to solve for π_t^e, π_t and y_t yields the following reduced forms:

$$\pi_t(g_t, m_t) \;=\; (1+\alpha\beta)^{-1}[\alpha\beta m_t + \alpha\gamma g_t + m_t^e + \frac{\gamma}{\beta} g_t^e + \alpha\epsilon_t + u_t] \tag{4}$$

$$y_t(g_t, m_t) \;=\; (1+\alpha\beta)^{-1}[\beta m_t + \gamma g_t - \beta m_t^e - \gamma g_t^e + \epsilon_t - \beta u_t]. \tag{5}$$

Equations (5) and (3) then imply

$$\begin{aligned}\tau_t(g_t, m_t) = [s(1+\alpha\beta)]^{-1}[(1+\alpha\beta+sb\beta)m_t \;-\; (1+\alpha\beta-sb\gamma)g_t \\ -\; sb\beta m_t^e \;-\; sb\gamma g_t^e \;+\; sb\epsilon_t \;-\; sb\beta u_t]\end{aligned} \tag{6}$$

3. Government and Central Bank Objectives

In our formulation, we allow for the possibility that the government and a fully independent central bank may differ in their objectives. In particular, we assume that the government cares about inflation stabilization, output growth, and income redistribution, whereas the central bank, if left to itself, would be concerned only with the first two objectives. We also assume that the government has been elected by majority vote, so that the government's loss function reflects society's preferences over alternative economic objectives.

Formally, the government's loss function is given by

$$L_t^g \;=\; \frac{1}{2}(\pi_t - \hat{\pi})^2 \;-\; \lambda_1^g y_t \;+\; \frac{\lambda_2^g}{2}[(b-\theta)y_t - \tau_t]^2 \tag{7}$$

where $\hat{\pi}$ is the government's inflation target, λ_1^g is the relative weight that the government assigns to output growth, and λ_2^g is the relative weight assigned to income redistribution. The parameter θ represents the proportion of national output that the government would, ideally, like to allocate to the rich. All other variables are as previously defined.

The first term on the right-hand side of (7) reflects the government's concern with inflation stabilization. Specifically, the government incurs losses when actual inflation deviates from the inflation target. The second term is intended to capture what many believe is a political reality for governments—namely, that voters reward governments for increases in output growth and penalize them for reductions in the growth rate.[6] The third component in the government's loss function reflects the government's concern with income redistribution. The parameter θ represents the government's ideal degree of income inequality. For example, in an economy in which there are as many rich people as poor people, an egalitarian government would set $\theta = 0.5$. Ideally, in this case, the government would like to redistribute output in the amount of $(b - 0.5)y_t$ from the rich to the poor.

We characterize the objectives of the central bank, which are distinct from those of the government, as:

$$L_t^{cb} = \frac{1}{2}(\pi_t - \hat{\pi})^2 - (1 - \delta)\lambda^{cb} y_t - \delta\lambda_1^g y_t + \frac{\delta\lambda_2^g}{2}[(b - \theta)y_t - \tau_t]^2 \tag{8}$$

where $0 \leq \delta \leq 1$, and λ^{cb} is the weight that the central bank assigns to output growth. The parameter δ measures the degree to which the central bank is forced to take the government's objectives into account when formulating monetary policy. The closer δ is to 0, the greater is the independence of the central bank.

In (7) we have described $\hat{\pi}$ as the government's's inflation target. The fact that the same inflation target appears in (8) reflects our assumption that the central bank may have instrument independence but not target independence.

4. The Policy Game

In all industrialized countries, fiscal policy is determined on an annual basis and

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[6] In adopting a linear representation of the output objective, we follow Barro and Gordon (1983). In the delegation literature, the output component in the government's loss function is usually quadratic because the models employed typically preclude any stabilization role for monetary policy when the output term in the loss function is linear. In our model, the quadratic income redistribution term in the loss function allows monetary policy to play a role in output stabilization.

budgets are usually prepared and adopted well in advance of their implementation. Monetary policy, on the other hand, is typically not predetermined in the same manner. It is therefore natural to model the interaction between the govenment and the central bank as a Stackelberg game in which the govenment takes on the leadership role.

We characterize the strategic interaction between the government and the central bank as a two-stage non-cooperative game in which the structure of the model and the objective functions are common knowledge. In the first stage, the government chooses the institutional parameters δ and λ^{cb}. The second stage is a Stackelberg game in which the government takes on the leadership role. In this stage, the government and the monetary authority set their policy instruments, given the δ and λ^{cb} values determined in the first stage. Private agents understand the game and form rational expectations for future prices in the second stage. Formally, the policy game can be described as follows:

Stage 1

The government solves the problem:

$$\begin{aligned}\min_{\delta,\,\lambda^{cb}} \ \mathrm{E}\, L^{g}(g_t, m_t, \delta,\, \lambda^{cb}) \quad = \quad & \mathrm{E}\left\{\frac{1}{2}[\pi_t(g_t, m_t) - \hat{\pi}]^2 \ - \ \lambda_1^g[y_t(g_t, m_t)]\right. \\ & \left. + \frac{\lambda_2^g}{2}[(b-\theta)y_t(g_t, m_t) - \tau_t(g_t, m_t)]^2\right\} \qquad (9)\end{aligned}$$

where $L^g(g_t, m_t, \delta,\, \lambda^{cb})$ is (7) evaluated at $(g_t, m_t, \delta,\, \lambda^{cb})$, and E is the expectations operator.

Stage 2

(i) Private agents form rational expectations about future prices π_t^e before the shocks u_t and ϵ_t are realized.

(ii) The shocks u_t and ϵ_t are realized and observed by the government and by the central bank.

(iii) The government chooses g_t, before m_t is chosen by the central bank, to minimize $L^g(g_t, m_t, \bar{\delta}, \bar{\lambda}^{cb})$, where $\bar{\delta}$ and $\bar{\lambda}^{cb}$ indicates that these variables were determined in stage 1.

(iv) The central bank chooses m_t, taking g_t as given, to minimize

$$\begin{aligned} L^{cb}(g_t, m_t, \bar{\delta}, \bar{\lambda}^{cb}) = \\ & \frac{(1-\bar{\delta})}{2}[\pi_t(g_t, m_t) - \hat{\pi}]^2 - (1-\bar{\delta})\bar{\lambda}^{cb}[y_t(g_t, m_t)] \\ & + \ \bar{\delta} L^g(g_t, m_t, \bar{\delta}, \bar{\lambda}^{cb}) \end{aligned} \tag{10}$$

The timing of our two-stage game is illustrated in Figure 1.

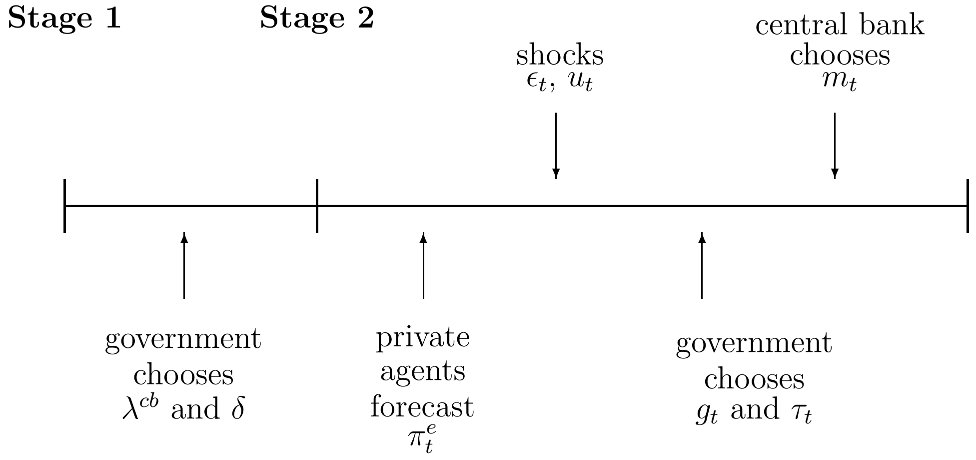

Figure 1: The Stages and Timing of the Policy Game

This game can be solved by first solving the second stage of the problem for the optimal money supply and government expenditure policies with δ and λ^{cb} fixed, and then solving stage 1 by substituting the stage 2 results into (9) and minimizing with respect to δ and λ^{cb}. The equilibrium for the stage 2 leader-follower game is:

$$\begin{aligned} m_t(\delta, \lambda^{cb}) \ = \ & \frac{\beta\hat{\pi}}{(\beta+\gamma)} + \frac{(1-\delta)\beta[\beta(\phi-\eta\Lambda)\lambda_2^g \ + \ \alpha\gamma(\beta\eta+\gamma)s^2]\lambda^{cb}}{\alpha(\beta+\gamma)[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)]\lambda_2^g} \\ & + \frac{\delta\beta[\beta\phi+\gamma\Lambda)\lambda_1^g}{\alpha(\beta+\gamma)[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)]} - \frac{(1-\gamma\theta s)u_t}{\alpha(\beta+\gamma)} \end{aligned}$$

$$- \frac{(1-\delta)\beta\gamma s^2(\beta\eta+\gamma)\lambda_1^g}{(\beta+\gamma)[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)]\lambda_2^g} - \frac{\epsilon_t}{(\beta+\gamma)} \tag{11}$$

$$\begin{aligned} g_t(\delta, \lambda^{cb}) \;=\; & \frac{\beta\hat{\pi}}{(\beta+\gamma)} + \frac{(1-\delta)\beta^2[(\phi-\eta\Lambda)\lambda_2^g - \alpha s^2(\beta\eta+\gamma)]\lambda^{cb}}{\alpha(\beta+\gamma)[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)]\lambda_2^g} \\ & + \frac{\delta\beta[\beta\phi+\gamma\Lambda)\lambda_1^g}{\alpha(\beta+\gamma)[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)]} - \frac{(1+\beta\theta s)u_t}{\alpha(\beta+\gamma)} \\ & + \frac{(1-\delta)(\beta s)^2(\beta\eta+\gamma)\lambda_1^g}{(\beta+\gamma)[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)]\lambda_2^g} - \frac{\epsilon_t}{(\beta+\gamma)} \end{aligned} \tag{12}$$

where

$$\eta \;=\; \frac{\partial m_t}{\partial g_t} \;=\; \frac{-\,\alpha^2\gamma\beta s^2 \;+\; \delta\phi\Lambda\lambda_2^g}{(\alpha\beta s)^2 \;+\; \delta\Lambda^2\lambda_2^g} \tag{13}$$

$$\phi \;=\; 1+\alpha\beta-\gamma\theta s \tag{14}$$

$$\Lambda \;=\; 1+\alpha\beta+\beta\theta s. \tag{15}$$

Taking the mathematical expectation of both sides of (11) and (12) to obtain m_t^e and g_t^e respectively, and substituting the result, together with (11) and (12), into (4) and (5) yields the reduced-form solutions for π_t and y_t as functions of the institutional parameters δ and λ^{cb}

$$\pi_t(\delta, \lambda^{cb}) \;=\; \hat{\pi} \;+\; \frac{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb} \;+\; \delta[\beta\phi+\gamma\Lambda]\lambda_1^g}{\alpha[\beta(\phi-\eta\Lambda) \;+\; \delta\Lambda(\beta\eta+\gamma)]} \tag{16}$$

$$y_t(\delta, \lambda^{cb}) \;=\; \frac{-u_t}{\alpha}. \tag{17}$$

From (6), the reduced-form solution for τ_t is given by

$$\tau_t(\delta, \lambda^{cb}) \;=\; \frac{(1-\delta)\beta s(\beta\eta+\gamma)(\lambda^{cb}-\lambda_1^g)}{[\beta(\phi-\eta\Lambda) \;+\; \delta\Lambda(\beta\eta+\gamma)]\lambda_2^g} \;-\; \frac{(b-\theta)u_t}{\alpha}. \tag{18}$$

Substituting (16)–(18) into (9), the government's stage 1 minimization problem can be expressed as

$$\min_{\delta,\lambda^{cb}} \;\; \mathrm{E}L^g(\delta, \lambda^{cb}) \;\;=\;\; \frac{1}{2}\left\{\frac{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb} \;+\; \delta[\beta\phi+\gamma\Lambda]\lambda_1^g}{\alpha[\beta(\phi-\eta\Lambda) \;+\; \delta\Lambda(\beta\eta+\gamma)]}\right\}^2$$

$$+\ \frac{\lambda_2^g}{2}\left\{\frac{(1-\delta)\beta s(\beta\eta+\gamma)(\lambda^{cb}-\lambda_1^g)}{[\beta(\phi-\eta\Lambda)\ +\ \delta\Lambda(\beta\eta+\gamma)]\lambda_2^g}\right\}^2 . \tag{19}$$

Partial differentiation of (19) with respect λ^{cb} and δ yields the first-order conditions

$$\begin{aligned}\frac{\partial \mathrm{E}L^g(\delta,\lambda^{cb})}{\partial\lambda^{cb}} \ &= \\ &\frac{[(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb}+\ \delta[\beta\phi+\gamma\Lambda]\lambda_1^g](1-\delta)\beta(\phi-\eta\Lambda)}{\alpha^2[\beta(\phi-\eta\Lambda)\ +\ \delta\Lambda(\beta\eta+\gamma)]^2} \\ &-\ \frac{(1-\delta)^2(\beta s)^2(\beta\eta+\gamma)^2(\lambda_1^g-\lambda^{cb})}{\lambda_2^g[\beta(\phi-\eta\Lambda)\ +\ \delta\Lambda(\beta\eta+\gamma)]^2}\ =\ 0\end{aligned} \tag{20}$$

$$\begin{aligned}\frac{\partial \mathrm{E}L^g(\delta,\lambda^{cb})}{\partial\delta} \ &= \\ &\frac{\begin{array}{l}(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb}+\delta[\beta\phi+\gamma\Lambda]\lambda_1^g\beta[\beta\phi+\gamma\Lambda] \\ \qquad (\lambda_1^g-\lambda^{cb})\left\{\delta(1-\delta)\Lambda\Omega+(\phi-\eta\Lambda)\right\}\end{array}}{\alpha^2[\beta(\phi-\eta\Lambda)\ +\ \delta\Lambda(\beta\eta+\gamma)]^3} \\ &\frac{\begin{array}{l}-\ (1-\delta)(\beta\eta+\gamma)(\beta s)^2[\beta\phi+\gamma\Lambda] \\ \qquad \left\{(\beta\eta+\gamma)-(1-\delta)\beta\Omega\right\}(\lambda_1^g-\lambda^{cb})^2\end{array}}{\lambda_2^g[\beta(\phi-\eta\Lambda)\ +\ \delta\Lambda(\beta\eta+\gamma)]^3}\ =\ 0\end{aligned} \tag{21}$$

where $\Omega = \partial\eta/\partial\delta$.

It is evident that $[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)] = 0$ is not a solution to the minimization problem. When $[\beta(\phi-\eta\Lambda)+\delta\Lambda(\beta\eta+\gamma)] \neq 0$, (20) and (21) yield, respectively, (22) and (23):

$$\begin{aligned}&(1-\delta)(\phi-\eta\Lambda)\lambda_2^g\left\{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb}+\delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\} \\ &\qquad -\ (1-\delta)^2(\beta\eta+\gamma)^2(\alpha s)^2\beta(\lambda_1^g-\lambda^{cb}) = 0\end{aligned} \tag{22}$$

$$\begin{aligned}&\left\{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb}+\delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\}(\lambda_1^g-\lambda^{cb}) \\ &\qquad \left\{\delta(1-\delta)\Lambda\Omega+(\phi-\eta\Lambda)\right\}\lambda_2^g \\ &-\ (1-\delta)(\beta\eta+\gamma)(\alpha s)^2\beta\left\{(\beta\eta+\gamma)-(1-\delta)\beta\Omega\right\}(\lambda_1^g-\lambda^{cb})^2 = 0.\end{aligned} \tag{23}$$

There are two real-valued solutions that satisfy the first-order conditions given above and which fall within the permissible range for δ.[7] By inspection, it is apparent that (22) and (23) are both satisfied when $\delta = 1$ and $\lambda^{cb} = \lambda_1^g$. This solution characterizes a central bank that is fully dependent. The second real-valued solution is $\delta = \lambda^{cb} = 0$. In this case, the central bank is fully independent and exclusively concerned with the economy's inflation performance.

The solution that yields the minimum loss for the government, as measured by the government's loss function (7), can be identified by using (19) to compare the expected loss that would be suffered under the alternative institutional arrangements. Substituting $\delta = 1$ and $\lambda^{cb} = \lambda_1^g$ into (19) results in

$$\mathrm{E}L^g \; = \; \frac{(\lambda_1^g)^2}{2\alpha^2}. \tag{24}$$

Substituting $\delta = \lambda^{cb} = 0$ into the right-hand-side of (19) yields

$$\mathrm{E}L^g \; = 0. \tag{25}$$

It is evident that when institutional arrangements are such that the government is the Stackelberg leader in the second stage, the optimal central bank design, from society's point of view, is one in which the central bank uses monetary policy to achieve the government's chosen inflation target and is granted full independence to do so. As we show in Appendix 2, central bank leadership does not provide as good a result from the government's point of view, *even if* the government dictates the inflation target.

Our results show that when there is government leadership, society's welfare, as measured by the inverse of (19), is maximized when the government appoints central bankers who are concerned only with the achievement of the mandated inflation target, and completely disregard the impact that their policies may have on output growth. However, our results also indicate that full central bank independence is

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[7] Because η is a function of δ, (23) is a quartic polynomial in δ. This polynomial has four distinct roots, of which only two are real-valued. Details of the complete solution set for the first-order conditions may be found in Appendix 1.

beneficial under more general conditions. When $\delta = 0$, $\beta\eta + \gamma = 0$, causing the strategic interactions between instruments to be offset. As a result (19) is given by

$$\mathrm{E}L^g \ = \frac{1}{2}\left\{\frac{\lambda^{cb}}{\alpha}\right\}^2 \tag{26}$$

for any arbitrary value of λ^{cb} when $\delta = 0$. An independent central bank will always produce better results as long as it is more conservative than the government ($\lambda^{cb} < \lambda_1^g$), irrespective of the latter's commitment to social equality (λ_2^g).

In deriving our results, we have assumed that the central bank has instrument independence but not target independence. Consequently, the fact that $\mathrm{E}L^g = 0$ can be achieved by setting $\delta = \lambda^{cb} = 0$ indicates that it is instrument independence which matters; and that target independence is ultimately irrelevant when there is government leadership. In fact, neither target independence nor central bank leadership would reduce society's expected loss to zero (see Appendix 2).

6. The Advantage of Government Leadership

6.1 Implications of the Theoretical Model

In Hughes Hallett and Weymark (2004a), we show that if, in the second stage of the game, government leadership is removed so that monetary and fiscal policy are implemented simultaneously, then the government's expected loss is given by

$$\mathrm{E}L^g \ = \frac{1}{2}\left\{\frac{\lambda_1^g}{\alpha}\right\}^2 \left\{\frac{(\alpha\gamma s)^2}{(\alpha\gamma s)^2 \ + \ \phi^2\lambda_2^g}\right\}. \tag{27}$$

Consequently, as long as the government has some commitment to social equality, so that $\lambda_2^g \neq 0$, (27) will always be smaller than the loss incurred when government leadership is combined with a dependent central bank .

A more interesting question is whether government leadership with an independent central bank generally produces better outcomes, from society's point of view, than those obtained in the simultaneous move game. In the simultaneous move game, the solution to the government's stage 1 minimization problem is

$$\delta \; = \; \frac{\beta\phi^2\lambda^{cb}\lambda_2^g \; + \; (\alpha\gamma)^2\beta(\lambda^{cb} - \lambda_1^g)}{\beta\phi^2\lambda^{cb}\lambda_2^g \; + \; (\alpha\gamma)^2\beta(\lambda^{cb} - \lambda_1^g) \; - \; \phi[\beta\phi + \gamma\Lambda]\lambda_1^g\lambda_2^g}.^{8} \tag{28}$$

The optimal degree of conservatism for an independent central bank in this type of game can be obtained by setting $\delta = 0$ in (28) to yield:

$$\lambda^{cb*} \; = \; \frac{(\alpha\gamma s)^2\lambda_1^g}{(\alpha\gamma s)^2 + \phi^2\lambda_2^g} \tag{29}$$

It is straightforward to show that (26) is always less than (27) as long as

$$\lambda^{cb} \; < \; \left[\lambda_1^g\lambda^{cb*}\right]^{1/2} \tag{30}$$

It is also evident that $\lambda^{cb*} \leq \lambda_1^g$ for $\lambda_2^g \geq 0$. Consequently, government leadership with any $\lambda^{cb} < \lambda^{cb*}$ will produce better outcomes, from society's point of view, than any simultaneous move game between the central bank and the government.[9] This is an important result because many inflation targeting regimes, such as those operated by the Bank of England, the Swedish Riksbank, and the Reserve Bank of New Zealand, operate with government leadership; while several others, notably the European Central bank and the US Federal Reserve System, are better characterized as being engaged in a simultaneous move game with their governments.

Substituting $\delta = 0$ and λ^{cb} into (16)–(18) shows exactly where the advantages of government leadership come from. We get

$$\pi_t \; = \; \hat{\pi}, \quad y_t \; = \; \frac{-u_t}{\alpha}, \quad \tau_t \; = \; \frac{-(b-\theta)u_t}{\alpha} \tag{31}$$

as the final outcomes. By contrast, the optimal outcomes for the corresponding simultaneous move policy game are

$$\pi_t^* \; = \; \hat{\pi} \; + \; \frac{\alpha(\gamma s)^2}{[(\alpha\gamma s)^2 \; + \; \phi^2\lambda_2^g]} \tag{32}$$

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[8] See Weymark (2003) for a full derivation of this result.

[9] Hughes Hallett and Weymark (2001) also show that λ^{cb*} is the critical value that is relevant for comparing government leadership to any simultaneous move regime, including those with $\delta \neq 0$. This result follows from the substitutability between δ and λ^{cb} in (28).

$$y_t^* = \frac{-u_t}{\alpha} \tag{33}$$

$$\tau_t^* = \frac{\gamma s(\lambda^{cb*} - \lambda_1^g)}{\phi\lambda_2^g} - \frac{(b-\theta)u_t}{\alpha} \tag{34}$$

Comparing the two sets of outcomes we see that government leadership eliminates inflationary bias and therefore results in a lower rate of inflation. The proximate reason for this surprising result is that optimization under government leadership is characterized by higher taxes and more income redistribution.[10] The deeper reason for this result is that there is a natural self-limiting effect associated with longer run effects of fiscal policy itself. Unless the impact of fiscal policy on output is large enough to generate savings that could finance both the fiscal expansion and a net transfer to the poor, each increase in output would necessarily be accompanied by greater income disparity. Hence, in order to preserve its longer term social equity objectives, the government is forced to raise taxes, and this offsets any inflationary pressures created by the expansion.

6.2 The Coordination Effect

One of the central issues addressed in the policy coordination literature is whether there are institutional arrangements that yield Pareto improvements over the standard non-cooperative outcomes.[11] When such institutions exist, they may be viewed as a coordination device.

In our model, the central bank is independent. Without further institutional restraints, interactions between an independent central bank and the government would lead to non-cooperative outcomes. But if the government is committed to long-term

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[10] Tax revenues are lower under the simultaneous move game because $\lambda^{cb*} < \lambda_1^g$. Redistribution is positively related to the amount of tax revenue because $(b-\theta)\mathrm{E}y_t^* = 0$, so that τ_t^* determines the amount of income redistribution actually achieved: $\mathrm{E}\tau_t = 0$ in (31) versus $\mathrm{E}\tau_t^* \leq 0$ in (34).

[11] See, for example, Currie, Holtham, and Hughes Hallett (1989); Currie (1990); Currie and Levine (1991), Hughes Hallett (1992, 1998); Hughes Hallett and Viegi (2002).

leadership in the manner we have described, the policy game becomes an example of rule-based coordiantion which brings about better outcomes for both parties without requiring any reduction in the central bank's independence.[12] However, both parties do not necessarily gain equally. If the inflation target is reduced after the govenment's budget (i.e., fiscal policy) has been determined, the government will gain less. This is an important point because it explains why granting leadership to a central bank whose priority for lower inflation exceeds that of the government produces no additional gains from the govenment's point of view. In our model, it is the impact on income redistribution that accounts for the majority of the coordination gains associated with government leadership. For this reason, granting leadership to a central bank that places no weight on income redistribution and a stonger priority on inflation control will result in smaller gains from the government's point of view. We demonstrate this result formally in Appendix 2.

6.3 Empirical Evidence

Whether or not the theoretical results we have obtained are of practical significance is an empirical matter. In Table 1 we have computed the optimal degrees of conservatism and the associated expected losses under the simultaneous move and government leadership solutions for nine countries. The data we have used is from 1998, which is the year the Eurozone was created. The data itself, and its sources, are summarized in the appendix to this article.

The countries selected fall into three groups:

(a) Eurozone countries: France, Germany, and Italy
(b) Non-EMU countries with explicit inflation targets: Sweden, Switzerland, and the UK
(c) Inflation targeters outside the EU: Canada, New Zealand, and the US.

In the first group, monetary policy is conducted at the European level, and fiscal policy is conducted independently at the national level. Policy interactions in this

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[12] See Currie (1990) for the distinction between rule-based and discretionary forms of policy coordination.

Table 1

Losses under Government Leadership and Simultaneous Moves

	Full Dependence $\delta = 1$ $\lambda^{cb} = \lambda_1^g$	Government Leadership $\delta = 0$ $\lambda^{cb} = 0$	Simultaneous Moves $\delta = 0$ $\lambda^{cb} = \lambda^{cb*}$	Growth Rate Equivalents Lost %
France	5.78	0.00	0.0125	1.26
Germany	16.14	0.00	0.0079	0.79
Italy	1.28	0.00	0.0116	1.16
Sweden	4.51	0.00	0.0098	0.98
Switzerland	4.79	0.00	0.0251	2.51
UK	3.37	0.00	0.0113	1.13
Canada	12.50	0.00	0.0265	2.65
New Zealand	8.40	0.00	0.0104	1.04
USA	6.47	0.00	0.0441	4.41

group can be characterized in terms of a simultaneous move game with target as well as instrument independence. The second group of countries has adopted explicit, and publicly announced inflation targets. Central banks in these countries have been granted instrument independence but not target independence. The government either sets, or helps set, the inflation target value. In each case the government has adopted longer term (supply side) fiscal policies, leaving active demand management to monetary policy. These are clear cases in which there is fiscal leadership, combined with instrument independence for the central bank.[13] Of the countries in the third group, New Zealand and Canada can also be described as explicit inflation targeters with fiscal leadership. The US, although not an explicit inflation targeter, is included in this group as a point of comparison.

The first column in Table 1 shows the losses that would be incurred with a fully

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[13] Switzerland is included in this group on the basis of the inflation targeting changes made after 1999. See Rich (2000) for a detailed analysis of the inflation targeting process in Switzerland.

dependent central bank, with or without fiscal leadership. Column two reflects the losses that would be incurred under government leadership with an independent central bank that directs monetary policy exclusively towards the achievement of lower inflation (i.e., with $\delta = \lambda^{cb} = 0$). The third column gives the minimum loss associated with simultaneous decision-making in the same game.[14] All three columns are measured in welfare units.

Evidently, complete dependence is extremely unfavourable for all countries. However, the magnitude of the loss varies considerably from country to country. The losses in column three, relative to those in column two, appear to be relatively small. However, we find these losses to be quite significant when they are converted into "growth rate equivalents." A growth rate equivalent is the loss in output growth that would produce the same welfare loss if all other variables remain at their optimized values.[15] Specifically, we compute the marginal rates of transformation around each government's indifference curve to find the change in output growth, dy_t, that yields the welfare loss given in column four when all other policy variables are held at the values that were used to obtain the losses reported in column three. Formally, from (7),

$$dy_t \;=\; \frac{(dEL_t^g)}{[\lambda_2^g\{(b-\theta)y_t - \tau_t\}(b-\theta) - \lambda_1^g]}. \tag{35}$$

The minimum value of dy_t is attained when the tax revenues τ_t grow at the same rate as the redistribution target $(b-\theta)y_t$. These minimum output losses are reported in column four.

The values in column four show that the losses associated with simultaneous decision-making are equivalent to permanent reductions of 1–2 percent in the long term growth rate of national income. That is, France, Germany and Italy might have doubled their 2003 growth rates had they adopted fiscal leadership; while growth

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[14] The losses reported in column three were calculated using $\lambda_1^g = 1$ and $\lambda_2^g = 0.5$ for each of the countries in the sample as in Hughes Hallett and Weymark (2001).

[15] This is a method of comparison borrowed from the policy coordination literature. See, for example, Currie et al (1989), Nolan (2002), and Oudiz and Sachs (1984).

Table 2

Central Bank Conservatism – λ^{cb}

	Government Leadership		Simultaneous Moves
	optimal value	upper bound	optimal value
France	0.00	0.0466	0.00217
Germany	0.00	0.0221	0.00049
Italy	0.00	0.0952	0.00906
Sweden	0.00	0.0467	0.00218
Switzerland	0.00	0.0725	0.00525
UK	0.00	0.0579	0.00335
Canada	0.00	0.0458	0.00212
New Zealand	0.00	0.0351	0.00123
USA	0.00	0.0826	0.00682

rates in Sweden, the UK and New Zealand would have been 50 percent lower without fiscal leadership. These are significant changes and are roughly equivalent to all the gains that might be expected from international policy coordination (Currie et al, 1989), or from the single currency in Europe (EC, 1990).

In Table 1 we have assumed that central banks operate optimally within each regime. However, (30) indicates that the government leadership regime does not need to be optimally configured in order to produce outcomes that are superior to those achieved in the simultaneous move regime. In Table 2, we provide estimates of the lowest degree of central bank conservatism (i.e., the highest value of λ^{cb}) for which fiscal leadership combined with central bank independence will dominate the optimal simultaneous-move regime. For Germany, the losses would be lower under government leadership with λ^{cb} values as much as 50 times larger than under the best simultaneous-move regime. In the case of Italy, fiscal leadership is beneficial for λ^{cb} values of up to 10 times larger than under the best simultaneous-move regime. The remaining six countries fall in between these two extremes.

The implication of these results is that instrument independence, coupled with fiscal leadership, allows policy makers a great deal more room for manouevre than other regimes do. Government leadership expands the feasible policy space in that both the central bank and the government can contemplate a wider range of policies to suit their own objectives and still expect to get better outcomes, from society's point of view, provided central bank independence is not lost. Conversely, a government leadership regime is likely to be less sensitive to any uncertainties about the transmission parameters, savings ratios, or targets for social equality that may appear around the economic cycle, or as new governments come into office. This last point may prove to be the greater advantage in practical applications.

7. Conclusion

In this article, we have developed a model of monetary delegation in which the government plays a leadership role. We find that when the government has the fiscal leadership, society's well-being (as we have defined it) is maximized by appointing a central banker whose only concern is the achievement of the government-mandated inflation target.

Our theoretical results show that government policy leadership, coupled with a fully independent, inflation-oriented central bank, will lead to a better economic performance, from society's point of view, than a simultaneous move game between the central bank and the government. In comparing the optimal economic outcomes that can be achieved under each of the two regimes, we find that fiscal leadership results in Pareto improvements for all players. Our model shows that these gains arise becuase leadership introduces an element of (implicit) coordination between the players, without requiring either player to relinquish any independence.

Our empirical analysis indicates that the benefits of government leadership are large enough to allow policy makers to achieve good outcomes with a much wider range of policies than in the simultaneous move regime. Moreover, because the success of the leadership regime is less sensitive to the precise choice of the degree of conservatism, it provides some protection against the impact of uncertainties in the transmission parameters or social objectives, or variations in the priorities for those objectives associated with changes in government.

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Appendix 1
Solutions to (22) and (23)

The first-order condition (23) can be written as a quartic polynomial in δ. As a consequence, there are four solutions that simultaneously satisfy (22) and (23). By inspection, it is apparent that one of these solutions is $\delta = 1$ and $\lambda^{cb} = \lambda_1^g$. When $\delta \neq 1$ and $\lambda^{cb} \neq \lambda_1^g$, the first order conditions can be written

$$\begin{aligned}(\phi - \eta\Lambda)\lambda_2^g \left\{(1-\delta)\beta(\phi - \eta\Lambda)\lambda^{cb} \;+\; \delta[\beta\phi + \gamma\Lambda]\lambda_1^g\right\} \\ -\;(1-\delta)(\beta\eta+\gamma)^2(\alpha s)^2\beta(\lambda_1^g - \lambda^{cb}) \;=\; 0 \qquad \text{(A.1)}\end{aligned}$$

$$\begin{aligned}\left[\delta(1-\delta)\Lambda\frac{\partial\eta}{\partial\delta} \;+\; (\phi-\eta\Lambda)\right]\left\{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb} \;+\; \delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\}\lambda_2^g \\ -\;(1-\delta)(\beta\eta+\gamma)(\alpha s)^2\beta\left[(\beta\eta+\gamma) \;-\; (1-\delta)\beta\frac{\partial\eta}{\partial\delta}\right](\lambda_1^g-\lambda^{cb}) \;=\; 0. \\ \text{(A.2)}\end{aligned}$$

But (A.2) can be expressed as

$$\begin{aligned}(A.1) \;+\; \delta(1-\delta)\Lambda\frac{\partial\eta}{\partial\delta}\left\{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb} + \delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\}\lambda_2^g \\ +\;(1-\delta)^2(\beta\eta+\gamma)\frac{\partial\eta}{\partial\delta}(\alpha\beta s)^2(\lambda_1^g-\lambda^{cb}) \;=\; 0. \quad \text{(A.3)}\end{aligned}$$

Consequently, when $\delta \neq 1$ and (A.1) is satisfied, (A.2) becomes

$$\begin{aligned}\delta\Lambda\left\{(1-\delta)\beta(\phi-\eta\Lambda)\lambda^{cb} + \delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\}\lambda_2^g \\ +\;(1-\delta)(\beta\eta+\gamma)(\alpha\beta s)^2(\lambda_1^g-\lambda^{cb}) \;=\; 0. \qquad \text{(A.4)}\end{aligned}$$

Replacing η with (13) yields

$$(\phi - \eta\Lambda) \;=\; \frac{\alpha^2\beta s^2[\beta\phi + \gamma\Lambda]}{(\alpha\beta s)^2 + \delta\Lambda^2\lambda_2^g} \qquad \text{and} \qquad (\beta\eta + \gamma) \;=\; \frac{\delta\Lambda[\beta\phi + \gamma\Lambda]\lambda_2^g}{(\alpha\beta s)^2 + \delta\Lambda^2\lambda_2^g}. \tag{A.5}$$

It is evident that $(\beta\eta + \gamma) = 0$ when $\delta = 0$. Hence $\delta = \lambda^{cb} = 0$ is one solution that satisfies (A.1) and (A.4).

The remaining potential solutions can be found by substituting (A.5) into (A.4) and solving for δ (under the assumption that $\delta \neq 0$ and $\delta \neq 1$). We obtain:

$$\delta^2 \;=\; \frac{-(\alpha\beta s)^2}{\Lambda^2\lambda_1^g\lambda_2^g}. \tag{A.6}$$

Consequently, there are only two real-valued solutions that satisfy the first-order necessary conditions: (i) $\delta = 1$ and $\lambda^{cb} = \lambda_1^g$, and (ii) $\delta = \lambda^{cb} = 0$.

Appendix 2
Central Bank Leadership

This appendix summarizes the results obtained when the central bank, rather than the government, is the Stackelberg leader in the second stage of the policy game. Because a central bank that plays a leadership role is almost certain to have target independence, we express the objectives of the central bank as follows:

$$L_t^{cb} = \frac{1}{2}(\pi_t - \hat{\pi}^{cb})^2 - (1-\delta)\lambda^{cb}y_t - \delta\lambda_1^g y_t + \frac{\delta\lambda_2^g}{2}[(b-\theta)y_t - \tau_t]^2 \tag{A.7}$$

where we allow the central bank's inflation target $\hat{\pi}^{cb}$ to differ from the government's inflation target $\hat{\pi}$.

When the central bank has full target independence and is the Stackelberg leader, the reduced-form solutions for π_t, y_t, and τ_t are:

$$\begin{aligned}\pi_t \;=\; & \frac{[(\beta+\mu\gamma)\phi\hat{\pi}^{cb} \;+\; \delta\gamma(\Lambda-\mu\phi)\hat{\pi}}{(\beta+\mu\gamma)\phi \;+\; \delta\gamma(\Lambda-\mu\phi)} + \frac{(1-\delta)(\beta+\mu\gamma)\phi\lambda^{cb}}{\alpha[(\beta+\mu\gamma)\phi \;+\; \delta\gamma(\Lambda-\mu\phi)]} \\ & + \frac{\delta[\beta\phi+\gamma\Lambda]\lambda_1^g}{\alpha[(\beta+\mu\gamma)\phi \;+\; \delta\gamma(\Lambda-\mu\phi)]}\end{aligned} \tag{A.8}$$

$$y_t = \frac{-u_t}{\alpha} \tag{A.9}$$

$$\begin{aligned}\tau_t &= \frac{\alpha\gamma s(\beta+\mu\gamma)(\hat{\pi}-\hat{\pi}^{cb})}{[(\beta+\mu\gamma)\phi \;+\; \delta\gamma(\Lambda-\mu\phi)]\lambda_2^g} \\ &\quad + \frac{(1-\delta)\gamma(\beta+\mu\gamma)s(\lambda_1^g-\lambda^{cb})}{[(\beta+\mu\gamma)\phi \;+\; \delta\gamma(\Lambda-\mu\phi)]\lambda_2^g} - \frac{(b-\theta)u_t}{\alpha}\end{aligned} \tag{A.10}$$

where $\mu = \dfrac{\partial g_t}{\partial m_t} = \dfrac{-\alpha^2\beta\gamma s^2 \;+\; \phi\Lambda\lambda_2^g}{(\alpha\gamma s)^2 \;+\; \phi^2\lambda_2^g}$.

Substituting (A.8)–(A.10) into the government's loss function (7) and differentiating with respect to λ^{cb} and δ yields the necessary first-order conditions:

$$\begin{aligned}\frac{\partial \mathrm{E}L_t^g}{\partial\lambda^{cb}} &= 0 \\ \Rightarrow \quad & (1-\delta)\phi\lambda_2^g\left\{-\alpha\Gamma\phi(\hat{\pi}-\hat{\pi}^{cb}) + \phi(1-\delta)\Gamma\lambda^{cb} + \delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\} \\ & - (\alpha\gamma s)^2\Gamma(1-\delta)\left[\alpha(\hat{\pi}-\hat{\pi}^{cb}) + (1-\delta)(\lambda_1^g-\lambda^{cb})\right] = 0\end{aligned} \tag{A.11}$$

$$\begin{aligned}\frac{\partial \mathrm{E}L_t^g}{\partial\lambda^{cb}} &= 0 \\ \Rightarrow \quad & \phi\lambda_2^g\Gamma\Sigma\left\{-\alpha(\beta+\mu\gamma)\phi(\hat{\pi}-\hat{\pi}^{cb}) + \phi(1-\delta)\Gamma\lambda^{cb} + \delta[\beta\phi+\gamma\Lambda]\lambda_1^g\right\} \\ & - (\alpha\gamma s)^2\Gamma^2\Sigma\left[\alpha(\hat{\pi}-\hat{\pi}^{cb}) + (1-\delta)(\lambda_1^g-\lambda^{cb})\right] = 0\end{aligned} \tag{A.12}$$

where

$$\Sigma = [\beta\phi+\gamma\Lambda](\lambda_1^g-\lambda^{cb}) \;+\; \alpha\gamma(\hat{\pi}-\hat{\pi}^{cb})(\Lambda-\mu\phi)$$

$$\Gamma = (\beta+\mu\gamma).$$

There are two solutions that satisfy both of the first-order conditions given above. By inspection, it is apparent that (A.11) and (A.12) are both satisfied when $\delta = 1$ and $\Gamma = 0$. When $0 \leq \delta < 1$ and $\Gamma \neq 0$, then (A.11) and (A.12) imply the following relationship between δ and λ^{cb}

$$\delta = \frac{(\beta+\mu\gamma)\left\{\phi^2\lambda^{cb}\lambda_2^g \;+\; (\alpha\gamma s)^2(\lambda^{cb}-\lambda_1^g) \;-\; \alpha[\phi^2\lambda_2^g+(\alpha\gamma s)^2](\hat{\pi}-\hat{\pi}^{cb})\right\}}{(\beta+\mu\gamma)\left\{\phi^2\lambda^{cb}\lambda_2^g \;+\; (\alpha\gamma s)^2(\lambda^{cb}-\lambda_1^g)\right\} \;-\; \phi[\beta\phi+\gamma\Lambda]\lambda_1^g\lambda_2^g}. \tag{A.13}$$

It is straightforward to show that the government's expected losses are minimized by combinations of δ and λ^{cb} that satisfy (A.13). Substituting (A.13) into into the right-hand-side of (19) then yields

$$\mathrm{E}L^g \;=\; \frac{(\lambda_1^g)^2}{2\alpha^2}\left\{\frac{(\alpha\gamma s)^2}{(\alpha\gamma s)^2+\phi^2\lambda_2^g}\right\}. \tag{A.14}$$

Comparing (A.15) with (25) shows that the government's (and society's) expected loss is greater under central bank leadership than under government leadership. In fact, the loss under central bank leadership is identical to the loss incurred by the government in a simultaneous move regime. Furthermore, target independence has no impact on economic outcomes or government losses as long as the government can alter the degree of central bank conservatism to compensate for the difference between its own inflation target and that of the central bank. To see this, note that when the central bank is fully independent (i.e., $\delta = 0$), the optimal degree of central bank conservatism (from A.13) is given by

$$\lambda^{cb} \;=\; \frac{(\alpha\gamma s)^2\lambda_1^g}{(\alpha\gamma s)^2 \;+\; \phi^2\lambda_2^g} \;+\; \alpha(\hat{\pi}-\hat{\pi}^{cb}). \tag{A.15}$$

Using a graphical representation of the policy game, it is straightforward to show that this outcome can be expected to hold in general. Hughes Hallett and Viegi (2002) have shown that the optimal reaction functions form an acute angle when the policy makers have targets in common but differing priorities. The greater the divergence between the priorities of the players, the more elliptical are the preferences ($\lambda^{cb} < \lambda_1^g$); and the greater the difference between the players' target values ($\hat{\pi}^{cb} < \hat{\pi}$), the wider is the angle betwen the reaction functions. It follows from this that if a measure of precommitment and conservatism is necessary to prevent opportunistic policies, then granting leadership to the party that is already more precommitted and conservative brings about smaller gains than would be attained by granting leadership to the less conservative and less precommitted player. Furthermore, greater is the divergence between the priorities and/or the target values of the players, the smaller are the additional gains that could be achieved by granting leadership to the more precommitted and more conservative of the players. Figure 1 illustrates this point.

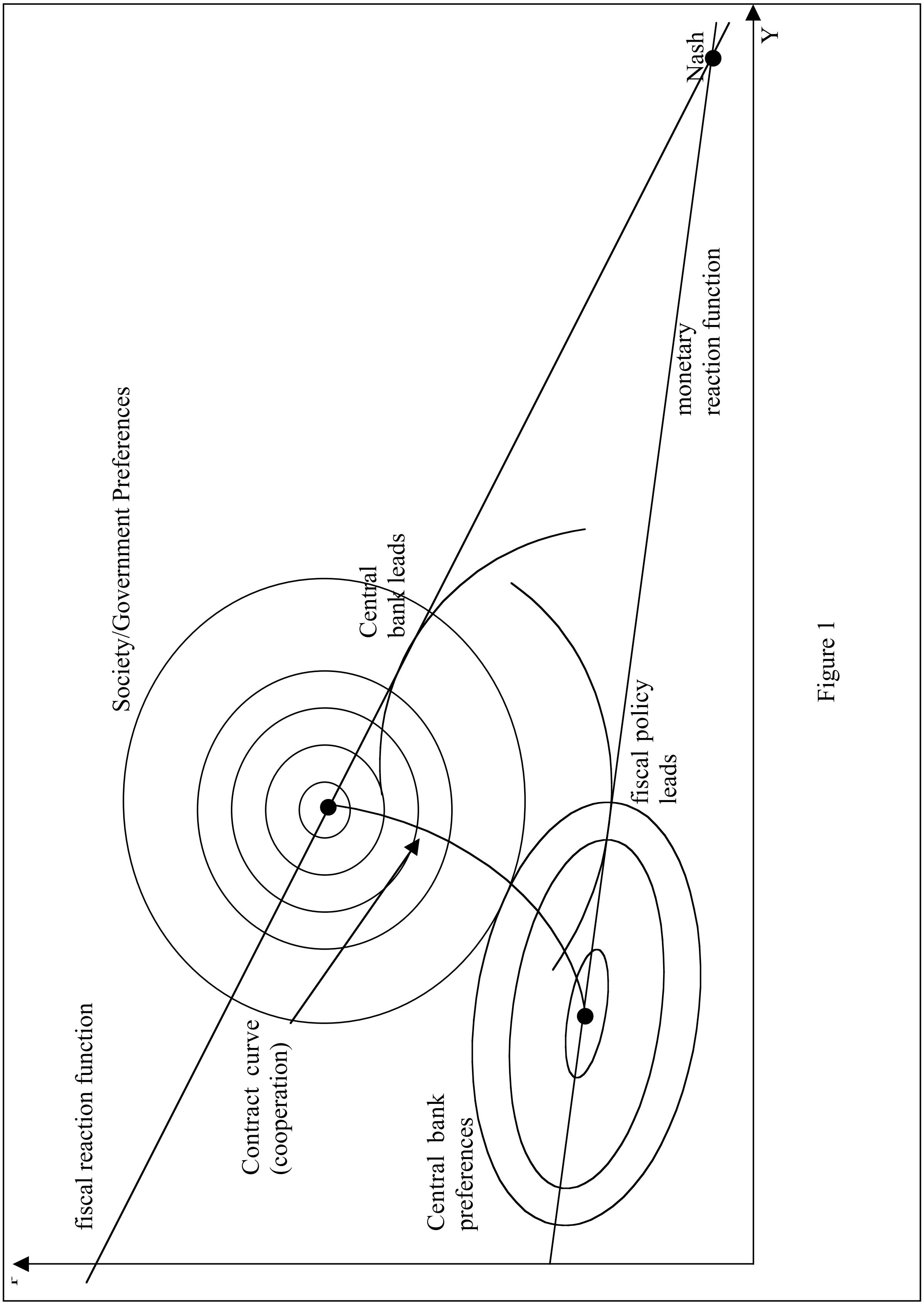
Society/Government Preferences
fiscal reaction function
Contract curve (cooperation)
Central bank preferences
Central bank leads
fiscal policy leads
monetary reaction function
Nash
Y
r

Figure 1

Table 3

Country-Specific Parameter Values

	α	β	γ	s	θ	ϕ
France	0.294	0.500	0.57	0.211	0.620	1.072
Germany	0.176	0.533	0.43	0.216	0.583	1.040
Italy	0.625	0.433	0.60	0.214	0.651	1.187
Sweden	0.333	0.489	0.533	0.206	0.504	1.107
Switzerland	0.323	0.489	0.533	0.3310	0.719	1.039
UK	0.385	0.133	0.58	0.180	0.675	0.980
Canada	0.200	0.400	0.850	0.185	0.725	0.966
New Zealand	0.244	0.400	0.850	0.124	0.596	1.035
US	0.278	0.467	1.150	0.184	0.597	1.004

Appendix 3
Data Sources and Parameter Values

The parameter values used in Section 6 are set out in Table 3. They come from different sources, and are offered as "best practice" estimates of the relevant parameters for a stylized facts analysis. The advantages of further econometric refinements, or consistency constraints on the underlying econometric specifications, would be lost if we varied the parameter values to capture the effects of different preference or transmission asymmetries on performance.

The Phillips curve parameter, α from (1), is the inverse of the annualized sacrifice ratios estimated on quarterly data from 1971-1998 by Turner and Seghezza (1999).[16] From (2), β and γ measure the effectiveness of monetary and fiscal policy, respectively. We obtained the β and γ values used in Tables 1 and 2 from John Taylor's (1993) multicountry econometric model; they are the simulated one-year policy mul-

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[16] Turner and Seghezza (1999) also note that there is no significant difference between the numerical estimates obtained from single-country estimation and OECD-wide systems estimation. This justifies our use of single country estimates in (1)-(3) for economies that are subject to spillover effects.

tipliers for each economy, jointly estimated in a model of interdependent economies. Thus, although our model (1)-(3) does not make spillovers between economies explicit, our numerical estimates do reflect the performance of an economy subject to such spillovers.

The national savings ratios s were obtained from OECD data (Economic Outlook, various issues). We chose to use 1998 data because that was the year in which EMU started. We also used 1998 OECD data to estimate the desired level of income equality θ. According to our model, θ measures the desired degree of income equality in terms of the desired proportion of output allocated to the rich. We therefore estimate θ as one minus the proportion of total fiscal expenditure allocated to social expenditures in each country.

Finally, λ_1^g and λ_2^g represent the ith country's preference for growth and income redistribution, respectively, relative to a unit penalty for inflation aversion. For lack of any direct evidence on these preference parameters, we have set $\lambda_1^g = 1$ and $\lambda_2^g = 0.5$, for each country in the sample.