How Independent Should a Central Bank Be?

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The case for an independent central bank is increasingly accepted. The central banks of Chile, France, Mexico, New Zealand, and Venezuela have all had their independence enhanced; the Maastricht treaty requires national central banks participating in the European System of Central Banks to meet a prescribed standard of independence; and a lively discussion is under way in Britain of the desirability of making the Bank of England, now explicitly subservient to the Treasury, independent.[1]

This new orthodoxy is based on three foundations: the success of the Bundesbank and the German economy over the past 40 years; the theoretical academic literature on the inflationary bias of discretionary policymaking; and the empirical academic literature on central bank independence.[2] Every orthodoxy, even an incipient one, deserves to be questioned;[3] and there is indeed reason to be careful about the lessons

[1] See, for instance, Roll Committee (1993) and Vibert (1993).

[2] The analytic literature starts from Kydland and Prescott (1977); most recently, see Persson and Tabellini (1993) and Walsh (1993). The academic literature on central bank independence is comprehensively summarized in Cukierman (1992); see also Cukierman and others (1993).

[3] Hall (1994) questions the new conventional wisdom by focusing on the Bundesbank, arguing that its success is due more to the nature of wage bargaining in the German economy than to its independence.

drawn from recent work. In particular, the literature does not establish that more independence is necessarily better than less.

We examine each of the three legs of the current argument for central bank independence. First, while the Bundesbank has achieved an enviable record of producing price stability, it has done so in 1993–94, as in the early 1980s, at a high price in terms of forgone output. It is not self-evident that the Bundesbank's trade-off between inflation and output should be emulated in other countries. Indeed, it is puzzling that a central bank that supposedly commands massive credibility has, since 1980, presided over two big recessions in order to maintain low inflation.

Second, the academic literature on dynamic inconsistency does not point directly to an independent central bank as the solution to the inflationary bias of discretionary policy; rather, dynamic inconsistency was advanced originally as an argument for a monetary rule rather than discretion, and a monetary rule does not need an independent central bank. The more relevant game-theoretic argument derives from the work of Rogoff (1985) and suggests the appointment of conservative central bankers as a solution to the inflationary bias problem.[4] But the Rogoff approach also implies that a central bank can be too independent to be socially optimal.[5] Recently this literature has been taken in a new direction by Walsh (1993) and Persson and Tabellini (1993) to examine incentive contracts for central bankers, along the lines of the contract of the Governor of the Reserve Bank of New Zealand (Dawe 1990).

The empirical literature on central bank independence shows a significant negative correlation between average inflation over 10-year periods and a measure of independence (constructed from legal provisions) among developed countries. However, the coefficient on this measure is positive, although not significant, in a regression that also includes less developed countries (Cukierman 1992, p. 420). The negative correlation among industrialized countries may reflect merely the common influence of a national aversion to inflation that affects both inflation and central bank independence: As shown below, countries with less aversion to inflation will tend to have less independent central banks.[6,7] Cukierman and colleagues (1993), attempting to deal with reverse causation, show that growth and central bank independence

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[4] Lohmann (1992) extends the Rogoff rule to allow the conservative central banker to be overruled by the government, at a cost; this produces a non-linear rule in which the central bank responds proportionately more strongly to large than to small disturbances.

[5] Freedman (1993) presents an interesting perspective on the increased interest in central bank independence, emphasizing the growing recognition of the need for a clear mandate for the central bank, and for central bank accountability.

[6] See Debelle (1994).

[7] Here the independence of the central bank is measured by the weight placed on inflation relative to that placed on output in the bank's loss function.

remain significantly positively correlated even when an instrumental variables procedure is used.

In discussing central bank independence, it is useful to draw a distinction between *goal independence* and *instrument independence*.[8] A central bank has goal independence when it is free to set the final goals of monetary policy. Thus, a central bank with goal independence could, for instance, decide that price stability was less important than output stability and act accordingly. Goal independence is related to the Grilli, Masciandaro, and Tabellini (1991) concept of political independence; however, by political independence they mean the central bank's ability to pursue the goal of low inflation free of political interference.[9] According to these authors, the German and Dutch central banks have the most political independence. A bank that has instrument independence is free to choose the means by which it seeks to achieve its goals.[10] The Reserve Bank of New Zealand, whose goals are precisely described in a contract with the government, has no goal independence; however, it has instrument independence since it chooses the method by which it tries to achieve the pre-assigned goals.[11] A central bank whose task was specified as attaining a given growth rate of the money stock would have neither goal nor instrument independence.[12]

In this paper we first review empirical evidence on the relationship between central bank independence and economic performance, in that context discussing the performance of the Bundesbank. Next a model developed by Debelle (1994) shows how to determine the optimal objective function for a central bank. We then discuss lessons of recent work on optimal incentive contracts for central banks and relate them to the distinction between goal and instrument independence for the central bank.

We will argue that industrialized countries face a real trade-off between the length and depth of recessions and the variability of inflation, and that the trade-off is not best left to a central bank that is isolated from political pressures. Rather, central banks need to be given a clear mandate and clear incentives to perform, and they must be *accountable* for their actions. Comparing the Federal Reserve and the

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[8] The distinction is related to that drawn by Grilli, Masciandaro, and Tabellini (1991) between *political* and *economic* independence.

[9] Although these authors state in their text that this is their criterion, all but one of the eight variables they include in their measure of political independence relate to freedom from government intervention in central bank decisions.

[10] The definition here differs slightly from that of Grilli and his colleagues, who define economic independence by the extent of government access to central bank credit, by whether the central bank sets the discount rate, and by whether it supervises banks.

[11] Grilli, Masciandaro, and Tabellini (1991) would describe the Reserve Bank of New Zealand as having complete political independence.

[12] A little ambiguity exists here, since technical decisions still have to be made in deciding how best to hit a given money supply target.

Bundesbank, we will argue that while the Bundesbank has successfully defined a clearer mandate for itself, the Fed comes closer to meeting the accountability criterion—and that each could benefit from moving in the direction of the other.

Empirical Evidence on
Central Bank Independence

Although both the Barro and Gordon (1983) and the Rogoff (1985) articles are usually cited in any discussion of the case for central bank independence, they have different implications. Barro and Gordon argue that the inflationary bias of the discretionary equilibrium in their model is a case for a monetary rule. In their initial non-stochastic equilibrium, the optimal rule would fix the money stock or money growth rate. Once uncertainty is introduced and the level of output is affected by shocks, the case becomes one for a feedback rule, in which monetary policy responds optimally to shocks. This would be a rule without discretion, and an independent central bank would not be needed, just a technical institute to implement the rule.

Rogoff's solution to the need for flexibility in monetary policy to respond to shocks is to install a conservative central banker with the discretion to respond to shocks and the conservatism to keep the mean rate of inflation low. Because the central banker is conservative, the response to shocks is also conservative; the optimal central banker is chosen by trading off the reduction in mean inflation secured by conservatism against the less than optimal trade-off between inflation and output variability produced by that same conservatism. It is not optimal in the Rogoff model to appoint a central banker whose only concern is low and stable inflation.

Interpreted in terms of goal and instrument independence, the Rogoff central bank can be thought of as having no goal independence— its goals are those of the appointed central banker—and full instrument independence.[13] It is important to note that the Rogoff model implies that if countries have central banks with differing degrees of conservatism, but are hit by similar shocks, then a trade-off should be observed between the variability of output and that of inflation, across countries.

The Rogoff approach is the basis for the definition of central bank independence as the relative weight on inflation in the central bank's loss function: The more single-mindedly the law specifies that a central bank seek to preserve the value of the currency, the more independent

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[13] Alternatively, one could say that instrument independence is not explicitly discussed in the Rogoff central bank model.

Figure 1

Inflation and Central Bank Independence[a]
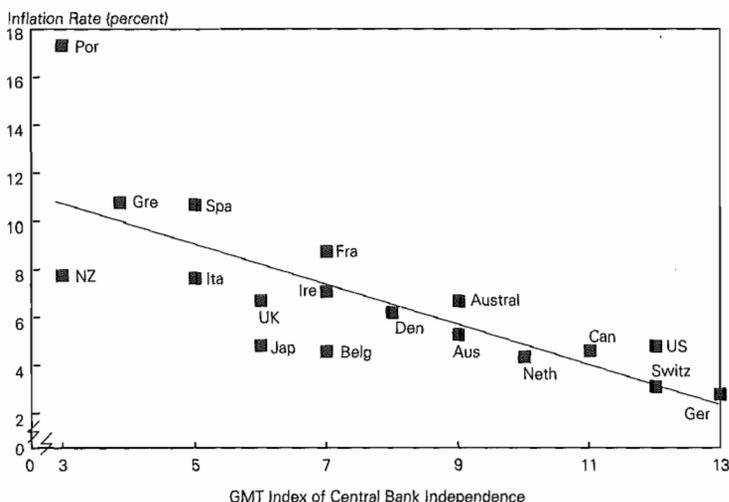
Industrialized Countries

Inflation Rate (percent)

GMT Index of Central Bank Independence

[a] As measured according to an index developed in Grilli, Masciandaro, and Tabellini (1991), here labeled GMT Index.

it is taken to be. This is the definition used in constructing most indices of central bank independence. It almost makes the basic empirical result of the independence literature, that central bank independence and inflation performance are negatively related (Figure 1), a tautology.[14] However, it is not a tautology, since the legal provisions on which most measures of central bank independence are based do not necessarily translate into effective action.[15]

The most striking result of the empirical work is that central bank independence appears to have *no* adverse consequences. Grilli, Masciandaro, and Tabellini (1991) show that the improved inflation performance associated with increased central bank independence for indus-

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[14] In Figure 1 the inflation rate is plotted against the GMT (Grilli, Masciandaro, and Tabellini) index of central bank independence. Cukierman (1992), Chapter 19, compares the different indices.

[15] As noted above, the basic result does not apply when the sample is extended to include developing countries (Cukierman 1992).

Figure 2

Variance in Inflation and in Output Growth

Industrialized Countries, 1960 to 1992

Variance in GDP Growth
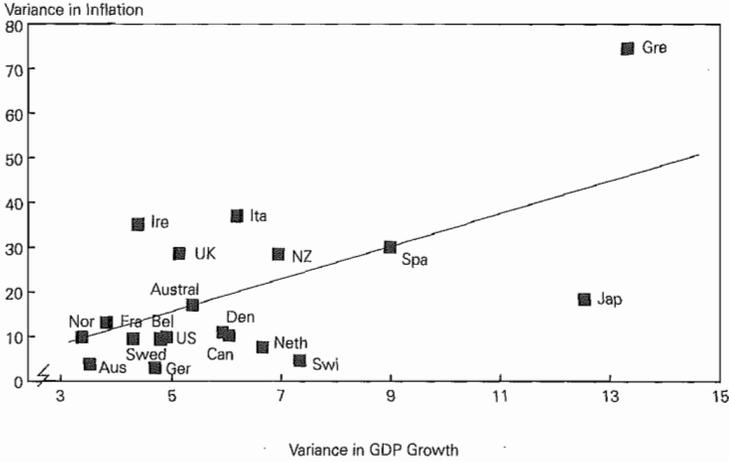
trialized countries does not come at a cost in terms of forgone growth. Similarly, for a cross-section of countries including less developed countries (LDCs), Cukierman and others (1993) find that while legal independence is negatively related to growth, the coefficient is not significant; an alternative (inverse) measure of central bank independence, the frequency of turnover of the central bank governor, is negatively related to growth (and positively related to inflation). Thus, improved inflation performance does not seem to come at a cost in terms of lower growth.

Figure 2 shows the relationship between the variability of inflation and the variability of GDP growth over the 1960–92 period, for the countries for which Grilli, Masciandaro, and Tabellini constructed measures of central bank independence (the GMT index). The association between these measures of variability is positive and significant, though the statistical significance disappears if Greece is excluded from the sample.[16]

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[16] Alesina and Summers (1993) and Eijffinger and Schaling (1993) examine the relationship between alternative measures of central bank independence and inflation and output growth variability. Eijffinger and Schaling find that inflation variability is significantly negatively related only to the GMT index (in two out of three decades), and that

The standard loss function in this literature penalizes deviations of the *level* of output from its target level, rather than the variability of output growth. Using measures of output deviations from linear and quadratic trends (of log output), we still find a positive but insignificant correlation between output and inflation variability.

These results could reflect either reverse causation from inflation aversion to central bank independence or, closely related, the presence of a third factor that produces both economic stability and independence. As noted above, Cukierman and others (1993) have investigated the reverse causation issue econometrically. Havrilesky and Granato (1993) include both measures of the extent of corporatism[17] and the index of central bank independence in a regression for the rate of inflation, and they find that none of the measures of corporatism, separately or all together, enter significantly. By contrast, Hall (1994) argues that centralized collective bargaining at the industry level (with IG Metall setting the pattern) is at least as much responsible for low inflation in Germany as is the independence of the Bundesbank.

On balance, the existing evidence suggests that central bank independence is a free lunch:[18] It brings lower inflation and lower inflation variability, at no cost in terms of lower output growth or greater output variability. We will investigate the relationship between legal independence and inflation in more detail below.

Nonetheless, an important anomaly remains. Recall the implication of the Rogoff model that a negative relationship would be expected between the variability of output and of inflation if countries were being hit by the same shocks, and if the central banks were efficient but differed in their relative tastes for inflation and output variability. At least three factors could account for the positive relationship that in fact obtains (Figure 2). If the variance of shocks differs systematically by country, then we would expect to find a positive relationship, with countries that are hit by bigger shocks[19] having greater variability of both inflation and GDP growth. Or, if some central banks are more efficient than others, they would do better at stabilizing on both dimensions. Or, if more independent central banks are also more credible on inflation,

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output growth variability is not significantly related to any of the measures of independence. Alesina and Summers find that inflation and inflation variability are negatively related to central bank independence, but that growth and the variability of growth are unaffected by it.

[17] They include three measures of the power of organized labor, two measures of the leftward leaning of the government, and two measures of the size of the public sector.

[18] This phrase was first used in the present context by Grilli, Masciandaro, and Tabellini (1991). See also Eijffinger and Schaling (1993) and Debelle (1994).

[19] These shocks could be self-inflicted: for instance, greater variability of government spending.

they may obtain a "credibility bonus" that makes the economy respond more rapidly to monetary policy changes.[20]

We are inclined to believe that the positive relationship between output and inflation variability shown in Figure 2 reflects both differences in the magnitude of shocks affecting different economies and differences in the efficiency with which policymakers respond to those shocks.[21] Countries with independent central banks are likely to be countries with more disciplined governments and thus are likely to suffer smaller self-inflicted shocks. Their central banks are likely to have better research staffs and abler and more experienced decision-makers. We suspect that the credibility bonus explanation would receive general support, but we are more skeptical and will return to the issue below.

The evidence reviewed here leaves little doubt that, on average, economic performance is better in countries with more independent central banks. But we will advance the view that, for the most sophisticated central banks, a trade-off remains between price level and output stability, and that a central bank can be too independent. We pursue the argument in a comparison of the Bundesbank and the Fed.

The Bundesbank and the Fed

Every central bank confronted with an inflationary shock has to decide how rapidly to try to reduce inflation; the more drastic the attempted correction, the larger will be the decline in output. To illustrate, by 1991 the Bundesbank knew that it faced rising inflation. It could at that point have tightened money and raised short-term interest rates to, say, 15 percent. Such a decision would have prevented some of the subsequent inflation, at a cost in terms of forgone output. Instead, it chose to fight the inflation more gradually. In the fall of 1993, it faced another decision, of whether to cut interest rates more rapidly, tending to increase output but at the cost of a slower decline in the inflation rate. It chose not to cut interest rates rapidly, thereby slowing the recovery from the recession.[22]

To return to the credibility bonus: It is widely agreed that the Bundesbank commands great credibility, as a result of both its indepen-

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[20] Kenneth Rogoff has pointed out that the relationship would also be positive if countries differ only in the wedge between the natural rate of unemployment and the socially optimal rate.

[21] Taylor (1982) argues that the trade-off between output and inflation variability can differ across countries due to "taste" or structural differences, but that a trade-off does exist.

[22] We take it for granted here that a short-run trade-off exists between output and inflation, and that every central bank believes that too.

Table 1
Estimates of the Sacrifice Ratio

Country	Disinflation Period	Length (Quarters)	Output Loss of GDP (%)	Initial Rate of Inflation (%)	Change in Inflation Rate (Percentage Points)	Sacrifice Ratio
United States	1969:IV–1971:IV	8	6.29	5.67	2.14	2.94
United States	1974:I–1976:IV	11	9.56	9.70	4.00	2.39
United States	1980:I–1984:III	15	16.20	12.10	8.83	1.83
United States	1989:IV–1993:I	13	6.05	5.02	2.03	2.98
Germany	1965:IV–1967:III	7	6.22	3.67	2.43	2.56
Germany	1973:I–1977:III	18	11.20	6.92	4.23	2.64
Germany	1981:I–1986:III	26	21.20	5.86	5.95	3.56
Germany	1992:II–			3.96		

Source: Output losses and periods of disinflation are taken from Ball (1993) with the inclusion of corrections from a later version of that paper, and the authors' calculations.

dence and its consistent anti-inflationary behavior. This credibility should have enabled it to deal with inflationary shocks at less output cost than less credible central banks, such as the Federal Reserve. Nonetheless, since 1980 it has had to produce two major recessions to keep inflation low. From 1980 to 1983, the German economy was in recession as the Bundesbank fought the consequences of the second oil shock. From 1992 to the present, mid 1994, the German economy has been in recession as it fights the consequences of unification.

In Table 1 we present estimates of the output costs (as a percentage of GDP) of recessions in Germany and the United States since the first oil shock in 1973. Surprisingly, the output cost of German recessions is higher than that of U.S. recessions. Indeed, the sacrifice ratio in Germany is generally larger than that for the United States for all recent recessions.

In Figure 3 we plot output losses in recessions since 1962 against the GMT Index measure of central bank independence.[23] The overall relationship is positive; it is also statistically significant. This implies that the output loss suffered during recessions has on average been larger, the greater the independence of the central bank.

Using an expectational Phillips curve

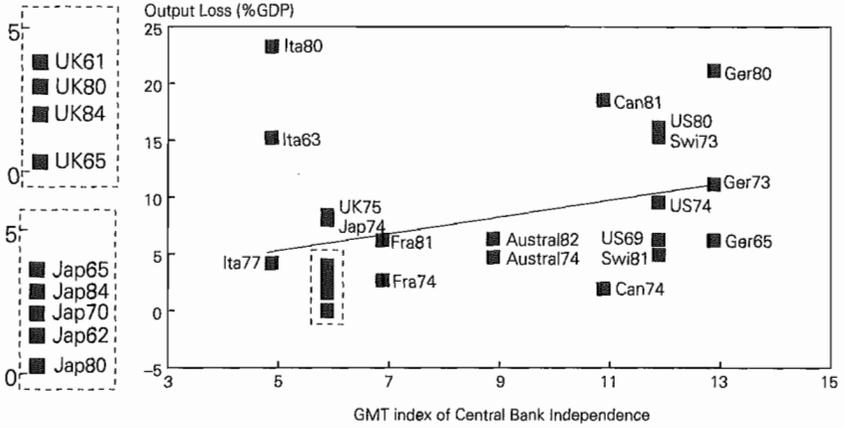$$y_t = y^* + \beta(\pi_t - \pi_t^e) + \varepsilon_t \tag{1}$$

[23] This relationship was discovered independently by Adam Posen (1993). The output loss measures are taken from Ball (1993) with the inclusion of corrections from a later version of that paper.

Figure 3

Output Loss and Central Bank Independence[a]

Industrialized Countries

^{a} As measured according to an index developed in Grilli, Masciandaro, and Tabellini (1991), here labeled GMT Index.

where y^* is the full employment level of output, π is the inflation rate, π_t^e is the expected inflation rate, and ε_t is a supply shock, the cumulative output loss during any disinflation is

$$L = \sum_{t_0}^{T} [\beta(\pi_t - \pi_t^e) + \varepsilon_t] \tag{2}$$

where t_0 is the starting point and T is the end of the disinflation. The more credible the central bank, the larger is β, for reasons demonstrated in Lucas (1973). Thus, comparing output losses in two countries, one factor, β, would tend to make the loss larger in the country with the more credible central bank: The Phillips curve in that country would be flatter. If the sum of unanticipated disinflation and the supply shocks were the same in the two countries, then the output loss would be higher in the country with the more credible central bank.

However, there is no reason whatsoever to expect the amount of unanticipated disinflation to be the same: When the more credible central bank announces that it will reduce inflation, the expected

inflation rate should fall, and output should not. Thus, it is a puzzle for those who believe that the Bundesbank should have a credibility bonus that Germany has had to go through recessions at least as severe as those in the United States in order to secure reasonable price stability, particularly given Hall's (1994) argument that the pattern of wage bargaining in Germany is more conducive to low inflation.

Indeed, this evidence gives the clear impression that the Bundesbank's credibility is far greater in the asset markets—at least judging from the newspapers[24]—than in the labor markets. At present we have no satisfactory explanation for this difference, but as the positive slope in Figure 3 shows, the phenomenon extends beyond the United States–Germany comparison: Countries with greater central bank independence tend to have greater output losses during recessions. This suggests that no credibility bonus exists in the labor markets for more independent central banks: They have to prove their toughness repeatedly, by being tough.

Ball, Mankiw, and Romer (1988) show that the Phillips curve is steeper at higher rates of inflation; thus, the higher output cost in Germany (say) may be caused by the fact that it started disinflating from a lower initial level of inflation. However, controlling for initial inflation, the positive relationship seen in Figure 2 still remains. An alternative explanation for the relationship in Figure 2 is that different labor market features may affect the slope of the Phillips curve and hence the amount of unemployment and output loss necessary to achieve a given disinflation. Accordingly, we have run regressions that include a number of variables to capture labor market institutions, including the degree of wage flexibility, the degree of labor market unity, and the replacement ratio.[25] Only the replacement ratio entered significantly, but central bank independence remained significant in all cases.

In Table 2 we present the mean inflation rates and growth rates, as well as the variability of inflation and growth[26] for the United States and Germany for the period 1960 to 1992. Inflation in Germany was lower than that in the United States over the period, and growth rates were the same. The United States has more stable output and less stable inflation. No doubt the United States could have had more stable inflation, if its central bank had been more devoted to fighting inflation. Should it have had such a central bank? While the empirical results on central bank independence appear to say yes, since greater independence comes with lower inflation and no evident costs, the comparison with German

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[24] That is to say, it is generally believed by asset market participants that the Bundesbank is a tough inflation fighter.

[25] The labor market variables are from Havrilesky and Granato (1993) and from Layard, Nickell, and Jackman (1991).

[26] Similar results hold for the variability of output around linear or quadratic trends.

Table 2
Inflation and Growth Rates and Variability

Quarterly data, Estimated over 1960 to 1992/3	United States	Germany
Average inflation	1.19	.84
Variance inflation	.69	.43
Average real growth	.73	.73
Variance real growth	.88	1.42
Sum squared residuals of log output against: Annual data		
linear trend	.049	.080
quadratic	.023	.029
Quarterly data		
linear	.208	.347
quadratic	.101	.128

performance suggests that a trade-off exists and that we should investigate further the question of how independent (in the sense of antiinflationary) the central bank should be.

How Inflation-Averse Should the Central Bank Be?

In this section we present a model, from Debelle (1994),[27] in which to consider the optimal degree of inflation aversion of the central bank. The model includes a central bank that sets the inflation rate and a fiscal authority that sets (distortionary) taxes and government spending and receives seigniorage from the central bank. Output is produced by labor, whose nominal wage is predetermined; firms maximize after-tax profits and can hire the amount of labor they demand at the predetermined nominal wage.[28]

Society's loss function, or the loss function of the social planner, is given by:[29]

$$V_S = \frac{1}{2}\left[s_\pi \pi_t^2 + s_x(x_t - x^*)^2\right]. \tag{3}$$

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[27] The model draws on Alesina and Tabellini (1987).

[28] The single-period version of the model is presented here; the model is extended in Debelle (1994) to two periods, which allows the government to issue debt.

[29] In Debelle (1994) the social loss function also includes government spending, as in the fiscal loss function below (equation 5). No significant results appear to depend on the inclusion of g, which is omitted here for easier computation.

This loss function may be interpreted as reflecting the preferences of the society or those of the government. It differs from the loss function of the fiscal authority (equation (5) below), which includes also the level of government spending.

The social planner desires to have inflation as close to zero as possible and to minimize the deviation of output (x) from its target level x^*. We set the inflation target at zero, recognizing that measurement error and perhaps downward nominal price rigidities imply a slightly higher rate, say around 2 percent.[30] The target x^* is the one that would be chosen if non-distortionary taxes were available; s_π and s_x are weights on the inflation and output objectives.

The monetary authority is also assumed to be concerned only about the levels of inflation and output:

$$V_M = \frac{1}{2}\left[\pi_t^2 + \mu(x_t - x^*)^2\right]. \tag{4}$$

The parameter μ denotes the relative weight the central bank places on output relative to inflation. It is generally interpreted as the inverse of the extent of central bank independence, and will be used in that sense unless otherwise noted. However, measures of central bank independence in the empirical literature incorporate financial linkages between the central bank and the government, as well as μ, and the framework of this paper will allow us to distinguish these concepts. The (standard) loss function (4) is consistent with most central bank charters, although these generally also include responsibilities for the financial system.

The fiscal authority's loss function

$$V_F = \frac{1}{2}\left[\delta_\pi \pi_t^2 + \delta_x(x_t - x^*)^2 + \delta_g(g_t - g^*)^2\right] \tag{5}$$

includes government spending as well as inflation and output. We assume that $\delta_x/\delta_\pi > \mu$, that is, that the fiscal authority puts relatively more weight on output relative to inflation than does the central bank.

Distortionary taxes are levied on production and are the only tax available to the government. An increase in taxation reduces output (which in equilibrium is always below its target level). Output is produced by labor, L, and is subject to a white noise productivity shock, a_t.

$$X_t = L^\gamma e^{a_t/2}. \tag{6}$$

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[30] Very little in this paper depends on the optimal inflation rate, though of course the evaluation of central bank independence, which assumes lower inflation is better, does.

Workers set the nominal wage, w (in logs), to achieve a target real wage w^*,[31] so that

$$w = w^* + p^e. \tag{7}$$

The representative firm's profit function is given by:

$$PL^\gamma e^{a_t/2}(1 - \tau) - wL. \tag{8}$$

Solving for the firm's labor demand, and assuming it can hire the labor it demands at the given nominal wage, gives (the log of) output supply:[32]

$$x_t = \alpha(\pi_t - \pi_t^e - \tau_t - w^* + \log\gamma) + \frac{a_t}{2(1 - \gamma)} \tag{9}$$

where $\alpha = \gamma/(1 - \gamma)$ and, for simplicity, we set $\gamma = 0.5$.[33]

The government budget constraint is given by[34]

$$g = \tau + \pi \tag{10}$$

where g and τ are expressed as a ratio to output. Although seigniorage is a non-linear function of inflation, it has been linearized here for simplicity; obviously, we assume that the economy is on the correct side of the Laffer curve.

Nash Equilibrium

The monetary authority chooses π_t and the government τ_t, taking expectations and each other's actions as given, after the workers have chosen the wage. Expectations are formed rationally. The reaction functions of the two authorities are as follows:

Monetary:

$$\pi = \frac{\mu}{1 + \mu} (\pi^e + \tau + C - g^* - a), \tag{11}$$

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[31] The target wage w^* may be explained by efficiency wage theories or an insider/outsider model. See the discussion in Alesina and Tabellini (1987), footnote 5, p. 621.

[32] Note that although the disturbance has been introduced in the supply function (6), it could as well have been incorporated directly as a demand shock in equation (9).

[33] Note from equation (10) that the problem of time inconsistency of optimal policy would disappear if the government had access to non-distortionary taxes, in this model as in Fischer (1980).

[34] As in Alesina and Tabellini (1987), the following assumptions are made. Money demand is given by $M_t = P_t + \bar{X}$ where $\bar{X}$ is independent of τ. Thus $\pi_t = m_t - m_{t-1}$. The government financing constraint is $G_t = \tau_t P_t X_t + M_t - M_{t-1}$ which when divided by nominal income gives $g_t = \tau + (M_t - M_{t-1})/M_t \bar{X}/X_t$ and hence approximates to equation (10).

Fiscal:

$$\tau = g^* + \frac{\delta_x - \delta_g}{\delta_x + \delta_g}\pi - \frac{\delta_x}{\delta_x + \delta_g}(\pi^e + C - g^* - a) \tag{12}$$

where $C \equiv (g^* + w^* - \log \gamma + x^*)$ is constant and independent of the policy weights.

These equations imply:

$$\pi_t = \frac{\mu\delta_g}{\delta_x + \delta_g + \mu\delta_g}C - \frac{\mu\delta_g}{\delta_x + \delta_g + 2\mu\delta_g}a_t, \tag{13}$$

$$x_t = x^* - \frac{\delta_g}{\delta_x + \delta_g + \mu\delta_g}C + \frac{\delta_g}{\delta_x + \delta_g + 2\mu\delta_g}a_t, \tag{14}$$

$$g_t = g^* - \frac{\delta_x}{\delta_x + \delta_g + \mu\delta_g}C + \frac{\delta_x}{\delta_x + \delta_g + 2\mu\delta_g}a_t, \tag{15}$$

$$\tau_t = g^* - \frac{\mu\delta_g + \delta_x}{\delta_x + \delta_g + \mu\delta_g}C + \frac{\mu\delta_g + \delta_x}{\delta_x + \delta_g + 2\mu\delta_g}a_t. \tag{16}$$

The key result is that, in contrast to the existing literature, inflation and output depend not only on the central bank's weight on output, but also on the fiscal authority's weights. They also depend on the parameters x^*, g^*, and w^*, which reflect the institutional and political structure of the economy.

The average level of inflation:

$$\bar{\pi} = \frac{\mu\delta_g}{\delta_x + \delta_g + \mu\delta_g}C \tag{17}$$

depends positively on the central bank's weight on output, μ. This is the standard time inconsistency problem: The more weight the central bank places on output, the greater the incentive to create surprise inflation. Since this is perceived by the workers, in equilibrium, higher inflation occurs but no gain in output. When the central bank's weight on output is zero ($\mu = 0$), then equilibrium inflation is zero.

Inflation depends positively on the spending target g^*, as an increase in the spending target requires more seigniorage financing. Inflation also depends positively on output and wages, as a higher output (employment) target or a higher real wage target increases the monetary authority's desire to inflate. Inflation depends negatively on

Table 3
Effects of Parameter Changes on the Economy

	↑ μ	↑ δ_x	↑ δ_g	↑ x^*	↑ g^*
Inflation	↑	↓	↑	↑	↑
Output deviation $|x - x^*|$	↓	↓	↑	↑	↑
Govt. spending deviation $|g - g^*|$	↓	↑	↓	↑	↑

μ: monetary weight on output
δ_x: fiscal weight on output
δ_g: fiscal weight on government spending
x^*: output target
g^*: government spending target

the ratio of the fiscal authority's weights (δ_x/δ_g). An increased weight on the government spending target means that taxes are increased, thus reducing output and increasing the incentive of the monetary authority to inflate. An increased weight on output means that the fiscal authority reduces taxes to increase output, thus moving output closer to its target and reducing the incentive to inflate.

The average levels of output and government spending fall short of their respective targets, reflecting the trade-off the fiscal authority faces between spending and output. The difference between realized and targeted output is decreasing in μ, and decreasing in δ_x/δ_g. An increase in μ means that the central bank places more weight on the output objective, thus inflating the economy more and decreasing the level of distortionary taxes, while the opposite applies to the government spending gap. Table 3 summarizes these influences of the parameters on the economy.

The variance of inflation:

$$\sigma_\pi^2 = \left[\frac{\mu}{\delta_x/\delta_g + 1 + 2\mu} \right]^2 \sigma_a^2 \tag{18}$$

depends *positively* on μ and negatively on δ_x/δ_g.

The variance of output:

$$\sigma_x^2 = \left[\frac{1}{(\delta_x/\delta_g) + 1 + 2\mu} \right]^2 \sigma_a^2 \tag{19}$$

depends *negatively* on μ and δ_x/δ_g.

The increase in the variance of output when central bank independence is increased reflects the trade-off between flexibility and commitment highlighted by Rogoff (1985) and Lohmann (1992) and discussed at the beginning of this paper. When central bank independence is

increased to reduce the time consistency problem, the willingness to respond to shocks is decreased.

Inflation and taxation may be positively or negatively correlated. They respond in opposite directions to the productivity shock, but in the same direction to changes in the parameters (g^*, w^*). Optimal tax theory implies that inflation should be positively correlated with the level of other distortionary taxes, as each tax should be set such that the marginal distortion is the same. However, that assumes that the taxes are set by one authority. Here, the inflation tax is set by the monetary authority, which has different objectives from the fiscal authority. It prefers less seigniorage, whereas the fiscal authority always wants a higher level of seigniorage for a given level of government spending. Empirical examination shows no definitive relationship between inflation and taxation.[35]

The general presumption in the literature is that the decline in inflation as a result of increasing central bank independence must always decrease the value of the loss function (except in terms of the loss of flexibility discussed above). However, this relies on the specification of the loss function solely in terms of the central bank's objectives. Here, although the inflation rate is clearly zero when the central bank is fully independent, society is not necessarily better off in this case. The expected loss in each period is:

$$E[V_S] = E\left[\pi^2 \left(s_\pi + \frac{s_x}{\mu^2} \right) \right] \qquad (20)$$

$$= [\text{Var}(\pi) + (E[\pi])^2]\left(s_\pi + \frac{s_x}{\mu^2} \right). \qquad (21)$$

The first term is increasing in μ; however, the second term is decreasing in μ, because while more central bank independence reduces the level and variance of inflation, it also decreases output.[36]

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[35] See Grilli, Masciandaro, and Tabellini (1991), who found no systematic relationship across countries between the changes in the tax rate (expressed as the ratio of tax revenue to GDP) and changes in seigniorage (defined as the change in the money base relative to GDP).

[36] This conclusion may be overstated if further negative effects of inflation exist that are not captured in this simple model. For instance, inflation may have a negative effect on productivity (Selody 1990; Fischer 1993).

Optimal Aversion to Inflation by the Central Bank

Rogoff (1985) solved for the optimal degree of inflation aversion of the conservative central banker. His results were extended by Lohmann (1992), who shows that social welfare can be increased, at a cost, if the government retains the ability to override the conservative central banker. In equilibrium, the government does not overrule the central bank, but the threat of overruling ensures that the central bank follows a non-linear rule in which it responds more vigorously to large shocks than it otherwise would.

Implicitly, the social loss function in these articles is assumed to be that of the (original) central banker; it fails to be optimized only because of dynamic inconsistency. In our calculation of the optimal μ, we minimize (21) with respect to μ, thereby minimizing the social loss function (3).

While we do not obtain an explicit solution for μ (although it can be determined easily numerically), we can demonstrate the intuitive results that the optimal degree of central bank independence

- increases with society's aversion to inflation, and
- decreases with society's weight on output.

Thus, not surprisingly, the extent of central bank independence (defined as the central bank's aversion to inflation) may be determined by the country's underlying aversion to inflation. It remains true that for a given degree of inflation aversion, a country that institutes an independent central bank—with optimally chosen μ—will do better than one that simply endows the central bank with society's social welfare function. In this sense, the proposition that central bank independence enhances economic performance remains valid despite the endogeneity of central bank independence.

Stackelberg Equilibria

Although central bank independence is usually identified with μ in theoretical applications, empirical measures of it are closer to a more conventional sense of independence. By including provisions such as the term of central bank board members, and who chooses the governor, they come closer to measuring the central bank's ability to make decisions that are independent of those of the government.

The analytic model developed above does allow for independent decision-making by the central bank. It is conventional to examine the properties of only the Nash equilibrium, in which each actor takes the actions of the other as given. An alternative sense of the independence of the central bank relates to its need to accommodate the actions of the fiscal authority. To the extent that the central bank can fix its actions independent of the particular policy choice of the fiscal authority, it may

be said to be more independent. We examine the effects of indepen-
dence in this sense by considering alternative Stackelberg equilibria.

Assume first that the fiscal authority moves first. The fiscal author-
ity can be thought of as having the superior commitment technology in
this case.[27] This yields the following inflation rate:

$$\pi_F = \frac{\delta_g \mu (1 + 2\mu)}{\delta_\pi \mu^2 + \delta_x + \delta_g(1 + \mu)(1 + 2\mu)} C$$

$$- \frac{\delta_g \mu (1 + 2\mu)}{\delta_\pi \mu^2 + \delta_x + \delta_g(1 + \mu)(1 + 2\mu) + \delta_g(1 + 2\mu)\mu} a_t. \quad (22)$$

The Stackelberg equilibrium in which the fiscal authority leads has
to be interpreted with care. In the equilibrium that underlies equation
(22), the fiscal authority sets the level of government spending, but the
monetary authority still gets to determine the inflation rate before the
level of taxes is set. However, in choosing g, the fiscal authority takes
into account the reaction of the monetary authority to the fiscal author-
ity's choice of g. This equilibrium may be a more appropriate description
of fiscal-monetary interactions in practice than the Nash equilibrium.

The fiscal authority may be the leader in another, more direct sense:
It can set both τ and g and force the monetary authority to print
whatever amount of money is needed to finance the deficit. This "fiscal
domination" equilibrium, an equilibrium not unknown in the real
world, is examined at the end of this section.

Alternatively, if the monetary authority is the leader, choosing π
first and leaving the fiscal authority to specify g or τ, the inflation rate is:

$$\pi_M = \frac{2\mu \delta_g^2}{(\delta_x + \delta_g)^2 + 2\mu \delta_g^2} C - \frac{2\mu \delta_g^2}{(\delta_x + \delta_g)^2 + 4\mu \delta_g^2} a_t. \quad (23)$$

A solution like (23) is more likely to obtain if the central bank has set a
money or inflation target path, from which it will deviate only under
well-defined conditions.

First we examine the inflation rates under these assumptions. We
would expect the inflation rate to be higher when the fiscal authority
leads than in the Nash equilibrium, and to be lower than in the Nash
equilibrium when the monetary authority leads. We can show

$$\pi_F > \pi_N \Leftrightarrow 2\delta_x > \delta_\pi \mu. \quad (24)$$

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[27] This interpretation was suggested by David Laibson.

Since the fiscal authority is likely to place more weight on output relative to inflation (δ_x/δ_π) than the monetary authority (μ), we expect $\pi_F > \pi_N$.

Comparing the inflation rate when the monetary authority is the leader with the Nash inflation rate:

$$\pi_M < \pi_N \Leftrightarrow \delta_x > \delta_g. \tag{25}$$

Inflation is lower when the central bank leads if $\delta_x > \delta_g$, a condition that is likely to obtain.

Society's loss functions under the two different scenarios are given by:

Monetary:

$$E[V_S] = [\text{Var}(\pi_M) + (E[\pi_M])^2]\left(s_\pi + \frac{s_x}{\mu^2}\left(\frac{\delta_x + \delta_g}{2}\right)^2\right), \tag{26}$$

Fiscal:

$$E[V_S] = [\text{Var}(\pi_F) + (E[\pi_F])^2]\left(s_\pi + \frac{s_x}{\mu^2}\right). \tag{27}$$

Next, we could ask whether it is better, from the viewpoint of society, for the central bank to be a Stackelberg leader. Comparing the expected value of the social loss function when the central bank is a Stackelberg leader with its value at the Nash equilibrium, the loss function is smaller (that is, society is better off) when the central bank leads if condition (25) above holds and if $\delta_g < 1$ and $\delta_g + \delta_x < 2$.[28] Thus, provided the fiscal authority weights output losses at the margin more heavily than increases in government spending and does not place a very high weight on output and government spending, it is better from a social viewpoint for the central bank to lead.

We can interpret this result as stating that it is better for the central bank to precommit to an inflation path than to move simultaneously with the fiscal authority, provided that the fiscal authority will not impose excessively distortionary taxes in order to finance desired government spending. This is not a ringing endorsement for monetary precommitment: Monetary precommitment can be expensive if the fiscal authority is not responsible.

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[28] This is a sufficient condition for society to be better off when the central bank is a Stackelberg leader. Note that the normalization in the loss functions is that the weight on inflation in the central bank's loss function is one. Further, it is assumed through the budget constraint (10) that one unit of g can be financed with one unit of inflation.

Society is always better off in the Nash equilibrium than if the fiscal authority leads, provided condition (24) holds, that is, provided the central bank is more inflation-averse than the fiscal authority.[39] Thus, independence of the central bank, in the sense that it is not required to finance a predetermined deficit, is desirable in this model.[40]

If the central bank is exceptionally weak, the fiscal authority may be able to force it to finance a pre-specified deficit. In this *fiscal domination* equilibrium, the fiscal authority in effect sets g, τ, and π, and the central bank is a cipher. If this happens, it appears likely that the inflation rate is higher than in the Nash equilibrium, and social welfare is lower.[41] This means that the Stackelberg equilibrium, in which the monetary authority leads, is preferable to fiscal domination—another argument for central bank independence, appropriately defined.

Summary of Findings

In the models in this section, as in Rogoff (1985), conservative central bankers underreact to output shocks. In addition, we have shown that:

- The optimal degree of conservatism of the central bank depends on the society's aversion to inflation and output fluctuations;
- Society will be better off if the central bank precommits to an inflation rate, provided the fiscal authority is reasonably well behaved;
- If the central bank is more inflation-averse than the fiscal authority, society will be worse off if the fiscal authority is able to determine the size of the deficit that must be financed by the central bank.

Optimal Incentive Contracts

Nothing in the above analysis points to the desirability of a central bank having unlimited independence. As in Rogoff's (1985) model, it is not optimal for the central bank to be monomaniacal about inflation; it should also react to output fluctuations.

But it is possible to do better than the "optimal" central bank of the preceding section. First, as previously noted, Lohmann (1992) shows in the context of the Rogoff model how a non-linear reaction function,

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[39] This is a sufficient condition.
[40] Debt financing is not possible in this single-period version of the model. Debelle (1994) examines the effects of debt financing in a two-period set-up.
[41] That is, this result holds for all but unusual parameter values.

enforced by the threat of government overruling of the central bank, can improve economic performance.

More radically, Walsh (1993) and Persson and Tabellini (1993) have shown that a contract between the government and the central banker, in which the central banker's remuneration is tied linearly to the negative of the inflation rate, can attain the first best equilibrium. They model the relationship between the central bank and the government in a principal-agent framework.

The conservative central banker reduces the inflationary bias of monetary policy that results from dynamic inconsistency, but at the cost of responding too conservatively to output disturbances. As Walsh shows, in the standard central bank loss function, the inflationary bias is the *same* in each state of nature. Accordingly, appointing a central banker who has the same loss function as society (equation 3), and penalizing the central banker by an amount proportional to the inflation rate, enables society to obtain the first best solution.[42]

It should be emphasized that while, in this contract solution, the government directly rewards the central banker purely on the basis of the behavior of the inflation rate, the central bank is also concerned about the stability of output. Monetary policy accordingly responds actively to output disturbances.

If the central banker is not motivated by a combination of a penalty[43] and society's loss function, then the government can attempt to motivate through rewards or penalties based on the behavior of both output and inflation.[44] Once again, it is possible to attain the first best solution.

This analysis again assumes that the loss function of the central bank is that of society. If it were not, but was still known at the time of the contract negotiation, the transfer would include an extra term reflecting the difference between society's and the central bank's loss functions. However, if the loss function of the central bank was not known, the central bank might have an incentive to create *less* than the socially desirable rate of inflation, because its payment is linear in the inflation rate.

The principal agent framework developed by Walsh and by Persson and Tabellini allows one to examine the issue of accountability. The central bank is accountable to the government (and hence the public) to

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[42] This result is obtained by Walsh (1993) and also by Persson and Tabellini (1993). Walsh shows that the first best can also be obtained by penalizing the central bank by an amount proportional to the money stock—which is stochastically related to the inflation rate.

[43] Of course, it is only the marginal penalty that matters; the central banker has to be sufficiently well paid to want to take the job despite the risk of having to pay penalties.

[44] To obtain the first best outcome in this case, it is necessary to condition the central banker's penalty on the desired level of output. Walsh suggests this is difficult and that the first best solution may on this account be unattainable. It is not obvious why there should be any problem announcing a target unemployment rate, such as 5.5 percent.

achieve its inflation target. If it does not, then it is fined (which may in reality, take the form of dismissal). This issue is taken up in the next section.

The Central Bank Mandate and Accountability

The theories we have examined in this paper all imply that the central bank should have a clear mandate, whether in the form of a utility or loss function that specifies what it is to maximize, or in the form of a specific contract that penalizes inflation. In general, the contract instructs the central bank to minimize the social loss function plus the penalty for excess inflation. These theories are not equipped to deal with a fuzzy mandate or loss function, and it is difficult from the perspective of such theories to see the benefits of allowing the bank discretion as to its goals. That is, these theories all imply that central banks *should not* have goal independence.

The Reserve Bank of New Zealand has a clearly stated mandate to produce a particular path for or rate of inflation, one that is negotiated with the government. The agreement with the government allows for the inflation rate to be affected by supply shocks. The Federal Reserve has a vague mandate; that is, it has considerable goal independence. The Bundesbank is required both to maintain the value of the currency and to support the economic program of the government, provided that does not conflict with the goal of monetary stability. All three of these central banks have instrument independence.

The model in which the fiscal authority is a Stackelberg leader points to the importance of not leaving the fiscal authority with the power to fix the amount of deficit that must be financed by the printing of money. This type of central bank independence—freedom from having to finance the government—is likely to enhance economic performance.

The literature discussed in the previous section highlights the notion of *accountability*, emphasized by John Crow, former Governor of the Bank of Canada, and by the Roll Committee (1993). The central bank can be held accountable either in having to justify its behavior, or in having to pay a penalty for bad outcomes (or be rewarded for good outcomes). Accountability mechanisms differ. The Fed is accountable to the Congress, and to public opinion. The Bank of England is accountable to the Treasury. The Governor of the Reserve Bank of New Zealand is accountable to the government for meeting his contract. The Bundesbank has very little accountability: It does not have to account for its behavior to the legislature, though it could be argued that it is accountable to public opinion.

In an attempt to see which features of central bank structures

account for superior inflation performance, we use the Grilli, Masciandaro, and Tabellini (1991) data and a series developed by Cukierman, Webb, and Neypati (1992). Recall that Grilli and his colleagues create an index of political independence: an equally weighted sum of zero or one dummies for different aspects of, first, the appointment procedures of the governor and board members and, second, the extent of commitment to a target of monetary stability. Their index of economic independence includes zero or one dummies for the extent to which the central bank is required to finance the government, its freedom to set interest rates, and whether it supervises banks.

We have created three indexes from these measures. The first is the presence of a statutory requirement that the central bank pursue monetary stability among its goals; this is called *INFOBJ*. The variable *INFOBJ* is a measure, albeit an imprecise one, of the *lack* of goal independence of the central bank. The second is the Grilli, Masciandaro, and Tabellini (GMT) measure of political independence, but excluding *INFOBJ*. This variable, *POL7*, includes the legal provisions relating to appointments and the central bank's relationship with the government. The third is the GMT measure of economic independence, minus the bank supervision criterion. This variable, *EC6*, consists of those measures relating to the central bank's right not to finance the government and its right to set the discount rate. It is a measure of instrument independence.

Cukierman, Webb, and Neypati examined the objectives of central banks laid out in their charters and ranked them on a scale from 0 to 1, depending on whether price stability was mentioned and whether other potentially conflicting objectives were included. We called this index *CUK*.

We ran regressions of the inflation rate against these four variables for 17 industrialized countries in the Grilli, Masciandaro, and Tabellini sample. Table 4 shows that the two variables most closely tied to inflation performance are INFOBJ and EC6. The variables grouped into POL7, which relate to appointment procedures, are not significantly related to inflation. However, while the (0, 1) objective variable INFOBJ was significant, the more disaggregated variable *CUK* was not.

Table 4 implies that inflation performance is likely to be better if the central bank has a mandate for monetary stability, that is, no goal independence, and if it has instrument independence. From this perspective, the Fed needs a less vague mandate.

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We conclude by discussing accountability and output–inflation trade-offs. We do not, at this stage, have any quantitative measures of the accountability of the central bank. To a very limited extent, the

Table 4
Inflation and the GMT Index

Variable	(1)	(2)	(3)	(4)	(5)
INFOBJ	−1.76	−2.28	−4.27		
	(1.72)	(1.61)	(1.30)		
POL7	−.41				
	(.45)				
EC6	−1.02	−1.02		−1.53	
	(.55)	(.55)		(.42)	
CUK					−.68
					(1.75)
$\bar{R}^2$	.44	.44	.37	.42	−.06

Standard errors in parentheses.

significance of *INFOBJ* in the equations in Table 4 provides some support for the notion that accountability matters; the extent is limited because inclusion of an objective in the charter does not mean the central bank is actually held accountable for achieving that objective.

Nonetheless, we suggest that accountability must be an important mechanism to improve central bank performance, for two reasons: First, all institutions need to be held accountable for their actions, or their performance suffers. Second, the cult of central bank independence, the appointment of independent central bankers, and the emphasis on inflation in the incentive contracts seen so far, appear to lead to an excessive concentration on inflation prevention and insufficient acknowledgment of the short-run trade-offs between inflation and output. Without accountability to elected representatives, such as the Congress, central banks run a very good chance of becoming too conservative. That is the argument for greater Bundesbank accountability.

This view runs into the obstacle that the trade-offs between inflation and output, and between inflation and output variability, implied by most of the models in this paper, do not show up in practice. We have run regressions similar to those in Table 4, with the growth rate of output and inflation and output variability as dependent variables, and have found no evidence of a trade-off. However, both theory and the comparison between the Bundesbank and the Fed in Table 1 suggest that a trade-off does exist for countries with first-rate central banks. And if the trade-off exists, then the most independent central bank is not likely to be the socially optimal central bank.

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Discussion

Robert E. Hall*

Government performance follows worldwide fads. The big fad recently has been totally unsustainable fiscal deficits. The fad in the 1970s was inflation. For reasons that escape explanation from my understanding of political economy, the current fad among central banks is to keep inflation close to zero. Calvo, Kydland-Prescott, and Barro-Gordon convinced me that the central bank will always inflate, for the same reason that a judge will impose too lenient a sentence on a miscreant—the crime has already been committed and the sentence cannot deter it. I am not sure that I am satisfied with any explanation as to why central banks have not played out their inevitable role as inflators under received theory.

Commitment provides a good answer to the general class of problems of which monetary policy is one. The Sentencing Act was a natural way to harness commitment as a way to get optimal sentences. Judges today are denied the power to be rationally but perversely lenient.

A long-standing body of advocacy, led by Milton Friedman, would take the same approach to monetary policy. We should tie our central bank's hands in just the same way we tie our judges' hands. We could prescribe money growth or, better, prescribe a rule for the federal funds rate, as John Taylor advocates. Alternatively, as Kenneth Rogoff has pointed out, we could appoint central bankers with preferences unrepresentative of social preferences, who weight the inflation objective heavily. We would grant the central bankers the power to determine monetary policy independently. The corresponding approach to sentencing criminals is to appoint tough judges.

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Walsh and Persson-Tabellini have shown that a better answer is to appoint central bankers with preferences in line with social preferences, but to put a penalty on inflation so as to offset the inflationary bias inherent in making decisions on the spot. Tough central bankers are undesirable because they do not care about recessions, just as tough judges would not be a good idea because they might convict the innocent.

As Guy Debelle and Stanley Fischer stress in their paper, nothing in this line of thought says anything should be vague about the goals we assign to our central bankers. If we grant any independence, we should be sure that we set up incentives to see that social goals are properly served. Alternatively, we could treat our central bankers as technicians, charged with maximizing the objective function we assign them. Theory does not distinguish between these alternatives, so the paper does not really deal with the theory of central bank independence.

Another aspect of independence has received quite a bit of attention at this conference, but is not considered in Debelle and Fischer's paper: how the central bank executes the maximization of the designated objective function. We could dictate operating procedures in detail, going beyond Taylor's prescription of the federal funds rate to saying exactly what instruments should be devoted to pegging that rate. Or we could grant the central bank's technicians the right to use judgment, so long as they achieve the right combination of unemployment and inflation.

The contributions of the paper are in two distinct areas: First, new empirical results comparing the actual performance of economies with hawkish or dovish central banks. Second, the last word in modeling the monetary policy problem.

Figure 1 in the paper is the basic empirical result. Hawkishness is measured on the horizontal axis by the Grilli-Masciandaro-Tabellini measure of central bank responsibility for the price level alone. To an impressive extent, countries get what they ask for from their central banks. Hawkish policies should, as a matter of theory, deliver lower price volatility and higher output volatility—this proposition received a lot of attention in the first and second sessions of this conference. Debelle and Fischer do not look directly at the price volatility issue, but by combining data from their Figures 1 and 2, we can see that the variance of inflation is generally low for hawks and high for doves, in line with theory. The major exception is Japan, a dove by the Grilli-Masciandaro-Tabellini measure but with a record of low inflation volatility.

The paper is schizophrenic on the relation between hawkishness and output volatility. Again, the paper omits the figure that would show the relation between the Grilli-Masciandaro-Tabellini index and the variance of output. The discussion observes that there is no sign that hawkish policies adversely affect real performance. Greece, a real dove

according to the index, has the worst variance of real growth. And the real hawks—Germany, Switzerland, and the United States—have very low growth variance. On the other hand, Figure 3 shows that hawkish countries tend to have worse recessions, in line with standard theory. Two hawkish countries with low output growth variance have the largest output loss from recessions—Germany and the United States. Oddly, the paper reaches the grand conclusion that hawkish policies deliver price stability and no cost by way of increased output variability, *before* the presentation and discussion of Figure 3. The conclusion seems to depend critically on the measure of output volatility. I believe that the variance of the growth of real output is not a good measure, but I recognize that any measure is controversial that is based on deviations from a trend, "full-employment," "potential," or other attempt to separate a low-frequency element.

The third section of the paper looks closely at two conspicuous hawks, Germany and the United States. Implicit in the discussion is the proposition that the Bundesbank is even more of a hawk than the Fed, although the two differ by only a single point on the Grilli-Masciandaro-Tabellini scale. The puzzle is that the German sacrifice ratio is larger than that for the United States, even though the Bundesbank presumably enjoys higher credibility. To me, this finding confirms how little we know about the sources of monetary non-neutrality. It is true that virually every theory of non-neutrality implies that the anti-inflation efforts of a credible central bank should come at a lower real cost; the finding in this paper may just show that the received theories are on the wrong track.

The theoretical model in this paper is the ultimate development of the Calvo, Kydland-Prescott, Barro-Gordon line of research. The monetary authority is seen as the strategic opponent of the fiscal authority, and all three possibilities of sequence of play are considered.

The Debelle-Fischer model flagrantly offends Friedman's natural rate law, which holds that the level of output is invariant to parameters of the monetary policy rule. Chronic, fully anticipated inflation stimulates output. The mechanism is the following: Labor supply is perfectly elastic. The government imposes a commodity tax that shifts labor demand adversely. Seigniorage is modeled as a non-distortionary alternative to the tax. Hence, a policy of higher inflation lowers the distortionary tax and raises output. This property tilts the assessment of policies in favor of inflationary ones.

One of the most conspicuous differences between European and American macroeconomics is that the former is comfortable with perfectly elastic labor supply (real wage rigidity) whereas the latter is not. The polar alternative—a vertical labor supply curve derived from Cobb-Douglas preferences—would require development of a full general-

equilibrium analysis, because policy would shift labor supply as well as labor demand.

With respect to the order of play, the paper concludes that it would be better if the central bank moved first. The essence of the argument is that monetary policy in that case commits not to respond to fiscal policy. I do not see the point of this analysis. If monetary policy can commit not to respond to subsequent fiscal policy, it could commit not to respond to anything, in which case the entire issue considered in this literature—fundamentally rooted in the inability to commit—would disappear. Only the model with simultaneous play seems interesting to me.

I strongly agree with the basic conclusion of the paper, which I would summarize in the following way: We should not appoint central bankers who reflect our own preferences—they will be much too inflationary. It is better to appoint hawks, but they will deliver lower average rates of inflation only by under-responding to recessions. It is even better to appoint central bankers with our own preferences, but add a specific penalty against chronic inflation.

An alternative way to get the same policy is to demote central bankers to technicians and not worry about their preferences. We could simply tell the central bank that they must hold the unemployment rate at 5.5 percent plus one-sixth of the consensus forecast of the rate of inflation over the next two years. This rather dovish policy would keep the economy on a path of around 2 or 3 percent average inflation, but it would call for quite aggressive countercyclical action in the face of spending shocks. The central bank could decide independently how to achieve the target but would never struggle with the issues considered in this paper.

References*

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*This list is limited to references not included in the paper by Debelle and Fischer.