Economic Issues, Vol. 3, Part 1, March 1998

Independent Central Banks: Coordination Problems and Budget Deficits

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Abstract

This paper develops a simple game-theoretic model to show how the independence of central banks can result in coordination problems with the fiscal authority and excessive budget deficits. In a Stackelberg equilibrium with the fiscal authority as leader, the budget deficit is optimal. In contrast, with the central bank as leader, the budget deficit is too high. While in a Nash equilibrium, the budget deficit is higher still.

1. Introduction

Policy-makers in many industrialized countries have been more and more persuaded of the benefits of moving towards increasing the independence of their central banks. Indeed, several countries including Italy, New Zealand and the United Kingdom have either moved significantly in this direction or are actively contemplating such moves in the future. The primary motivation behind these developments is the belief that by increasing the autonomy of central banks monetary policy will be guided more by long-term anti-inflationary considerations than by the concerns of day-to-day political expediency. This belief has only been reinforced by the empirical observation that countries with relatively more independent central banks have been associated with relatively favourable macroeconomic outcomes (see, e.g. Alesina, 1988, 1989; Alesina and Summers, 1993; Grilli, Masciandaro and Tabellini, 1991) and has been further buttressed by dynamic inconsistency theories of inflation due to Kydland and Prescott (1977), Barro and Gordon (1983) and Rogoff (1985). In addition, the recent literature on central bank performance contracts that views the conduct of monetary policy as a principal-agent problem also points in this direction. Early work in this rapidly evolving area (e.g. Walsh, 1995; Persson and Tabellini, 1993) concentrated on the idea that the government, as principal, had to have some method of controlling the behaviour of the central bank, as agent, in the setting of a socially desirable monetary policy and suggested the notion of a carefully-crafted performance contract, whereby the central bank would be enticed into pursuing the 'correct' policy. More recently, however, it has become increasingly recognized that a more accurate depiction of this principal-agent problem may be to view the electorate as the principal, the government as an intermediate agent and the central bank as the ultimate agent. In this more complex scenario, the government may well have an incentive to misuse monetary policy for short-term electoral considerations and, consequently, to design sub-optimal performance contracts for the central bank, implying that the only real solution to the problem may be to make central banks totally independent (see, e.g. Fratianni, von Hagen and Waller, 1997).[2]

One problem with the general idea of increasing the independence of central banks, however, is the possibility that this can lead to coordination problems with the fiscal authority and the potential for excessive budget deficits.[3] Consider the game played between the central bank and the fiscal authority: One of the reasons governments may have for not cutting the budget deficit is that doing so would contract aggregate demand. This would pose no great problem if monetary and fiscal policy were chosen jointly by a single agency, because any contractionary change in fiscal policy could always be offset by an expansionary change in monetary policy, leaving aggregate demand unchanged while reducing the budget deficit to its desired level. But, with an independent central bank, the fiscal authority cannot rely on such an offsetting expansionary monetary policy and, consequently, excessive budget deficits may appear.

This paper develops a simple model to articulate this theoretical argument. The organization of the paper is as follows: Section 2 outlines the model, Section 3 addresses the policy coordination problem, and Section 4 concludes.

2. The model

We consider a simple game with two players: Finance, a unitary fiscal authority, and Central Bank, a unitary monetary authority. Finance controls the policy instrument of fiscal policy, F, and Central Bank controls the policy instrument of monetary policy, M. We make the crucial, but empirically defensible assumption that, other things being equal, Finance wants aggregate demand to be more expansionary than does Central Bank. Theoretically, there are various ways to motivate this assumption. One way is to assume simply that Finance wants a higher rate of inflation than does Central Bank, perhaps because Finance wishes to redistribute wealth away from lenders, e.g. holders of long-term nominal bonds that Finance itself has issued, and towards borrowers. An alternative way is to invoke the Barro and Gordon (1983) model of inflation, where the level of aggregate demand and inflation chosen by the policy-maker is positively related to both the weight placed on unemployment in its loss function and its rate of time preference. After all, an elected fiscal authority is far more likely to place a greater weight on unemployment in its loss function and/or display a higher rate of time preference than is an independent central bank.

Together, fiscal and monetary policy determine the overall level of aggregate demand, A, which should be thought of as representing *nominal* aggregate demand, or the position of the aggregate demand *curve*, so as not to imply that fiscal or monetary policy could have a long run effect on real output. With little loss of generality, we define units for A, F, and M so that their relationship is linear

$$A = F + M \qquad (1)$$

Finance and Central Bank have objective functions defined over the policy targets A and F. The two players are assumed to care about fiscal policy both for its effect on aggregate demand and intrinsically, i.e. for its effects on the inter-generational tax burden, for example, but to care about monetary policy only for its effect on aggregate demand. For simplicity, we assume that the two objective functions are separable in A and F, so that each player has a target level of aggregate demand, A^*, and a target level of fiscal policy, F^*, and that the two policy targets are independent, so that for any exogenously given level of aggregate demand

the optimal fiscal policy is always F^* and vice versa. Moreover, we assume that Finance and Central Bank share exactly the same view on the fiscal policy target, F^*, which can be justified, at least in the contemporary UK context, in terms of the Maastricht criteria. Finance, however, always desires a higher level of aggregate demand than does Central Bank, $A^{F^*} > A_{CB}^*$. Finally, again for simplicity, we assume that Finance and Central Bank have loss functions quadratic in the deviation of aggregate demand and fiscal policy from their targets

$$L_F = (F-F^*)^2 + (A-A_F^*)^2 \quad (2)$$

$$L_{CB} = (F-F^*)^2 + (A-A_{CB}^*)^2 \quad (3)$$

3. The policy coordination problem

The efficient solution to this game is clear. Both Finance and Central Bank agree that fiscal policy should be set at the level and aggregate demand is determined at some compromise level between and depending on the relative strengths of the two players.

For a non-cooperative game, however, where we have an independent central bank, the solution is not so simple. Consider, for example, the Nash equilibrium where Finance and Central Bank move simultaneously. Whatever level of fiscal policy is chosen by Finance, Central Bank will always want to choose monetary policy to attain its target level of aggregate demand. Thus Central Bank's reaction function is

$$M = A_{CB}^* - F \quad (4)$$

Finance's problem, on the other hand, is a little more complicated, since it has to consider both the intrinsic target for fiscal policy and the effect of fiscal policy on attaining its target level of aggregate demand. Minimizing its loss function, (2), taking M as given, Finance's reaction function is[4]

$$F = (1/2)(A_F^* + F^* - M) \quad (5)$$

More intuitively, using (1), this may be rewritten as

$$(A-A_F^*) + (F-F^*) = 0 \quad (6)$$

which highlights the fact that if Finance cannot attain its targets for both aggregate demand and fiscal policy exactly, then it must compromise and will choose a point midway between them.

Solving the two reaction functions, (4) and (5), simultaneously yields the Nash equilibrium $\{A_N, F_N\}$

$$A_N = A_{CB}^*, F_N = F^* + (A_F^* - A_{CB}^*) \quad (7)$$

where $(A_F^* - A_{CB}^*) > 0$ (by assumption). Central Bank achieves its target level of aggregate demand exactly - there has been no compromise between the two aggregate demand targets, while with respect to fiscal policy, upon which Finance and Central Bank agree, the end result is more expansionary than desired (and has been exactly offset by a contractionary monetary policy in order to attain Central Bank's target for aggregate demand).

This somewhat paradoxical result is best understood by comparing it to a situation where, instead of moving simultaneously, Finance moves first and plays Stackelberg leader to Central Bank's follower. In the Stackelberg game, Finance knows that however expansionary a fiscal policy it chooses, Central Bank will set a correspondingly contractionary monetary policy in order to hit Central Bank's own

target level of aggregate demand. Substituting Central Bank's reaction function into Finance's loss function, Finance sees that it must abandon the attempt to influence aggregate demand, and so sets fiscal policy to hit its intrinsic target. Thus, the Finance Leader Stackelberg equilibrium $\{A_{FL},F_{FL}\}$, found by minimizing (2) subject to (4), is given by

$$A_{FL} = A_{CB}^{*}, F_{FL} = F^{*} \tag{8}$$

Notice the interesting result that having Finance as the Stackelberg leader leads to exactly the outcome desired by Central Bank.

In the alternative Stackelberg equilibrium, on the other hand, in which Central Bank is the leader and Finance the follower, Central Bank is forced to compromise between its aggregate demand and intrinsic fiscal policy targets, for it knows that if it tries to hit its aggregate demand target, with a more contractionary monetary policy than Finance would want, Finance will partially counteract this by adopting a more expansionary fiscal policy, seeking a compromise between its own aggregate demand and intrinsic fiscal policy targets. Substituting Finance's reaction function, (6), into Central Bank's loss function, (3), and then minimizing, we find the Central Bank Stackelberg equilibrium $\{A_{CBL},F_{CBL}\}$ is given by

$$\begin{aligned} A_{CBL} &= (1/2)(A_{F}^{*}+A_{CB}^{*}), F_{CBL} \\ &= F^{*}+(1/2)(A_{F}^{*}-A_{CB}^{*}) \end{aligned} \tag{9}$$

Clearly, aggregate demand is a compromise - midway between the two players' targets, while fiscal policy is more expansionary than desired, but less so than in the simultaneous Nash equilibrium.

To summarize, we have outlined three possible non-cooperative equilibria: first, the Nash equilibrium, where Central Bank attains its aggregate demand target and the deficit is higher than optimal; second, the Finance Leader Stackelberg equilibrium, where the Central Bank again attains its aggregate demand target, but where the deficit is optimal; and third, the Central Bank Leader Stackelberg equilibrium, where aggregate demand is a compromise between the two players' targets and the deficit is higher than optimal, but not as high as in the Nash equilibrium. Notice that in both the Nash and Central Bank Leader Stackelberg equilibria a deficit appears even if neither player desires it and, moreover, the size of the deficit increases with the difference between Finance and Central Bank's view of the target level of aggregate demand. The message is clear: Central bank independence has the potential to cause excessive budget deficits.

In addition, we believe that our analysis can shed some light on the historical growth of deficits. During the post-war Keynesian consensus, monetary and fiscal authorities would typically agree on the appropriate target level of aggregate demand to achieve full employment. Moreover, fiscal policy would change only at budget time, whereas monetary policy would change continuously as central banks followed their discretion in actively adjusting monetary policy to new information so that fiscal authorities always moved first and central banks followed. This period could well be viewed in our framework as one in which we had a Finance Leader Stackelberg equilibrium. The result, for both these reasons, was relatively small deficits. Then, with the rise of monetarism, central banks desired a more restrictive aggregate demand policy and, equally importantly, began to assert their independence. Furthermore, if central banks committed themselves once and for all to a fixed time path for the money supply, to which the fiscal authorities would react, there would be

something of a move towards either the Nash or the Central Bank Leader Stackelberg equilibrium and consequently larger than optimal deficits.

4. Conclusion

This paper has developed a simple model to articulate the possibility that increasing the independence of central banks can lead to coordination problems with the fiscal authority and the potential for excessive budget deficits. In a Stackelberg equilibrium with the fiscal authority as leader, the budget deficit is optimal. In contrast, with the central bank as leader, the budget deficit is too high. While in a Nash equilibrium, the budget deficit is higher still.

Endnotes

1. Department of Economics, Carleton University, Ottawa. We should like to thank the editor and two anonymous referees for very helpful comments on an earlier version of the paper. The usual disclaimer applies.

2. For an accessible introduction to the new literature on central bank performance contracts, see Masciandaro (1995) or Waller (1995).

3. For a recent survey of game-theoretic models in this area, see Pollard (1993). Important contributions include those of Andersen and Schneider (1986), Tabellini (1986), Loewy (1988) and Nordhaus (1994). See also Cukierman (1992) and the review by Goodhart (1994). What distinguishes our model from the previous literature is the assumption that monetary policy matters only because of its effect on (nominal) aggregate demand, whereas fiscal policy is assumed to matter not only for its effect on aggregate demand, but also intrinsically, i.e. for its effects on the inter-generational tax burden, for example.

4. Derivations of equations (5) to (9) appear in the appendix.

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Appendix: Mathematical derivations of equations (5) to (9).

1. Derivation of (5): [Minimize (2), taking M as given]

Recall (2)

$$L_F = (L_F - F^*)^2 + (A - A_F^*)^2$$
$$= (F - F^*)^2 + ((F+M) - A_F^*)^2 \text{ (using (1))}$$

Hence

$$\frac{\partial L_F}{\partial F} = 4F - 2F^* + 2M - 2A_F^*$$

Set equal to 0 and solve yielding:

$$F = (1/2)(A_F^* + F^* - M)$$

2. Derivation of (6):

Recall (5) $F = (1/2)(A_F^* + F^* - M)$

Substitute from (1) for M

$$F = (1/2)(A_F^* + F^* - (A - F))$$
$$\Rightarrow 2F = (A_F^* + F^* - A + F)$$
$$\Rightarrow (A - A_F^*) + (F - F^*) = 0$$

3. Derivation of (7): [Solve (4) and (5) simultaneously]

Recall (4) $M = A_{CB}^* - F$

Rearrange $A_{CB}^* - F = M$ (A.1)

Recall (5)

$$F = (1/2)(A_F^* + F^* - M)$$
$$\Rightarrow 2F = (A_F^* + F^* - M) \qquad (A.2)$$

Add (A.1) and (A.2)

$$A_{CB}^* + F = A_F^* + F^*$$
$$\Rightarrow F_N = F^* + (A_F^* - A_{CB}^*)$$

Consider (A.1) $A_{CB}^* - F = M$

or $A_{CB}^* - F = A - F$ (using (1))

Substitute for F using F_N

$$A_{CB}^* - F_N = A - F_N$$

$$\Rightarrow A_N = A_{CB}^*$$

4. Derivation of (8): [Minimize (2), subject to (4)]

Recall (4) $M = A_{CB}^* - F$

Rewrite (4) using (1)

$$A - F = A_{CB}^* - F$$

$$\Rightarrow A_{FL} = A_{CB}^*$$

Recall (2)

$$L_F = (F - F^*)^2 + (A - A_F^*)^2$$
$$= (F - F^*)^2 + (A_{CB}^* - A_F^*)^2$$

(substituting from above)

Hence

$$\frac{\partial L_F}{\partial F} = 2F - 2F^*$$

Set equal to 0 and solve yielding: $F_{FL} = F^*$

5. Derivation of (9): [Minimize (3), subject to (6)]

Recall (3) $L_{CB} = (F - F^*)^2 + (A - A_{CB}^*)^2$
and (6) $(A - A_F^*) + (F - F^*) = 0$

Rearrange (6) $A = A_F^* - F + F^*$

and substitute into (3) yielding

$$L_{CB} = (F - F^*)^2 + ((A_F^* - A_{CB}^*) + (F^* - F))^2$$

Hence

$$\frac{\partial L_{CB}}{\partial F} = 4F - 4F^* - 2(A_F^* - A_{CB}^*)$$

Set equal to 0 and solve yielding:

$$F_{CBL} = F^* + (1/2)(A_F^* - A_{CB})$$

Rearrange (6) $F = F^* - (A - A_F^*)$

and substitute into (3) yielding

$$L_{CB} = ((F^* - (A - A_F^*)) - F^*)^2 + (A - A_{CB}^*)^2$$
$$= (A - A_F^*)^2 + (A - A_{CB}^*)^2$$

Hence

$$\frac{\partial L_{CB}}{\partial A} = 4A - 2(A_F^* + A_{CB}^*)$$

Set equal to 0 and solve yielding:

$$A_{CBL} = (1/2)(A_F^* + A_{CB}^*)$$