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INTERACTION BETWEEN CENTRAL BANK BEHAVIOR AND FISCAL POLICYMAKING: THE CASE OF THE U.S.

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ABSTRACT

Federal Reserve behavior is analyzed using a model which incorporates an effect of fiscal pressure on monetary policy formulation. Incentive structures are hypothesized to be such that the central bank plans over a longer horizon than that relevant to the administration. With the cyclically adjusted deficit proxying for fiscal pressure from the administration, the response to the deficit then plays an interactive role in affecting the trade-off weights applied to the competing goals of monetary policy. The model performs well for the U.S., and provides a pattern of policy that is stable over the full 1961-1983 period.

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1. INTRODUCTION

Recent empirical work has cast doubt both on the stability of the Federal Reserve's reaction function and on the possible link between deficit accommodation and monetary policy.[1] Instability across presidential administrations has, in particular, been found by Froyen (1974), Luckett and Potts (1978) and Hamburger and Zwick (1981, 1982). Indeed, Luckett and Potts obtain evidence of a shift in monetary policy between each of the Eisenhower, Kennedy-Johnson, and Nixon-Ford administrations. Most notable is the apparent passage from a dominant price-stability objective under Eisenhower to an emphasis on full-employment under Kennedy-Johnson. Hamburger and Zwick meanwhile find structural breaks to coincide, first, with the accedence of Kennedy, and, second, with the brief tenure of the Ford administration. In short, there appears to be at least some support for the following viewpoint expressed by Weintraub (1978, p. 356): "From the Accord until now, much of the history of monetary policy can be explained just by noting who the President was when the policy under review was in effect."[2]

One method of dealing with the implied structural shifts is to correct for them by using a dummy variable technique (Allen and Smith, 1983). However, in this paper I show that it is possible to identify a stable pattern of Federal Reserve behavior by use of a model that internalizes the influence of administration pressure on the central bank.[3] In the analysis, the cyclically adjusted deficit is used as a proxy for this pressure -- with the deficit in fact playing a multiplicative role in influencing the trade-off weights attached to stabilization goals. The postulated scenario is one in which the objective function of the administration together with that of the central bank jointly determine the course of monetary policy.

2. DEVELOPMENT OF THE MODEL

The focus on fiscal pressure as a determinant of monetary policy presupposes a distinction between the respective loss functions adhered to by the monetary and fiscal authorities. Otherwise, the central bank would already be conforming to the pattern of behavior desired by the fiscal authority and there would be no apparent basis for any conflict. The fundamental question here is in fact taken to be that of the time horizons that are relevant to the two bodies. Indeed, the length and staggered nature of the terms of office given to the governors of the Fed implies an incentive to consider future implications of current policy.

The importance of a time horizon extending beyond the next election has been pointed to by Buchanan and Wagner (1977), who emphasise the inherently short-term nature of the incentives facing politicians. In addressing the implications of this for anti-inflationary policy it is certainly relevant that the economic payoffs resulting from a contractionary monetary policy are delayed, while an adverse impact on interest rates and output tends to be immediate. Furthermore, in terms of the reputational implications discussed by Barro and Gordon (1983a,b), it is indeed the policymaker's discount rate that is crucial in determining whether the policymaker forgoes the short-term benefits available from unanticipated inflation in order to secure the gain from low average inflation over the longer term.

In the Barro and Gordon model it is shown that, ceteris paribus, the lower the discount rate, the closer the outcome to the model's optimal solution in which the policymaker follows a zero money growth rule.

The central bank and government are depicted as having distinct loss functions related to a range of economic variables. These variables are embodied in the vector Y_t, and are associated with the corresponding set of target values Y_t^*. These targets are assumed here to be common to both central bank and government. The respective weights attached to deviations from the targets can be represented by Q_1 and Q_2 below:

$$LCB = (Y_t - Y_t^*)'Q_1(Y_t - Y_t^*) \quad (1)$$

$$LGOV = (Y_t - Y_t^*)'Q_2(Y_t - Y_t^*) \quad (2)$$

where LCB is the loss function for the central bank,

LGOV is the loss function for the government.

The longer view that has been ascribed to the central bank would be expected to result in $Q_1 \neq Q_2$. The problem faced by each policymaker then becomes that of minimizing the relevant loss function subject to the constraint represented by the structure of the economy. The stochastic process determining the realization of the set of endogenous variables for the system can be represented by equation (3).

$$Y_t = AW_t + BX_t + u_t \quad (3)$$

where Y_t is an $N \times 1$ vector of target variables,

W_t is a $K \times 1$ vector of policy instruments,

X_t is an $M \times 1$ vector of predetermined variables (lagged values of the targets and instruments),

A is an $N \times K$ matrix of coefficients of the instruments,

B is an $N \times M$ matrix of coefficients of the predetermined variables,

u_t is an $N \times 1$ disturbance vector.

Following Wood (1967), substitution of (3) into the appropriate loss function can now be applied in order to derive the optimal strategy for the policymaker. The solution is illustrated for the general loss function

$$L = (Y_t - Y_t^*)'Q(Y_t - Y_t^*) \tag{4}$$

Minimizing L with respect to the instruments and solving for the optimal strategy, W_t^*, gives

$$W_t^* = CX_t + DY_t^* \tag{5}$$

where $C = -(A'QA)^{-1}A'QB,$

$D = (A'QA)^{-1}A'Q.$

If Y_t^* is taken as being uncorrelated with X_t, then the solution collapses simply to a closed loop rule contingent on past values of the targets and instruments. We write

$$W_t^* = CX_t + \varepsilon \tag{6}$$

where ε is equal to DY_t^*, and has a non-zero mean. Evolution of the target values over time implies that ε is not necessarily serially independent.

The outcome of this procedure indeed shows C (and ε) to be a function, not only of the system's matrices given in (3), but also of the relevant weightings of the trade-off between target variables as embodied in Q. Therefore, a difference in trade-off weights, i.e. $Q_1 \neq Q_2$, is seen to imply a similar distinction between the respective optimal response patterns for the central bank and government -- even were the perceived structure of the economy to be identical and both policymakers to use the same model.

The implication of the above for the setting of policy may now be considered -- first of all, from the perspective of the government. Here, the government's direct control of fiscal policy is taken to be embodied in the cyclically adjusted deficit. The feedback rule for the deficit has the form

$$DEF_t = \alpha X_t + \varepsilon_\alpha \tag{7}$$

where DEF_t is a measure of the cyclically adjusted deficit.

It is also possible to define a corresponding decision rule that the government would follow were it setting monetary policy. The relevant instrument in this case is taken to be the change in the monetary base.[4]

$$DMB_t^{GOV} = \beta X_t + \varepsilon_\beta \tag{8}$$

where DMB_t is the change in the monetary base.

However, it is of course the central bank which is entrusted with direct control over monetary policy. In the feedback rules (7) and (8) above, the coefficient vectors and error terms are necessarily a function of Q_2 from the government's loss function. Were the central bank itself able to set policy in an unconstrained manner, then formulation of policy would be related to Q_1 from the bank's own loss function (1) -- and not at all to Q_2. The reaction function is written as

$$DMB_t^{CB} = \gamma X_t + \varepsilon_\gamma \tag{9}$$

To the extent that $Q_1 \neq Q_2$, it could be expected that $\beta \neq \gamma$, $\varepsilon_\beta \neq \varepsilon_\gamma$. At the same time, the central bank must take into account the potential threat to its autonomy arising in circumstances of sustained opposition to the government -- with the aftermath of the 'Coyne affair' in Canada providing an illustration of the dangers inherent in any prolonged state of conflict.[5] Indeed, the setting of policy is examined now in the context of an extended loss function for the central bank which allows for the influence of pressure that may be exerted by the government. The loss associated with this pressure would relate to the perceived threat to central bank autonomy. The extent of the pressure is itself taken to depend upon the gap between the monetary policy which the government would have selected itself (from 8) and the monetary policy actually followed.

The extended loss function has the form

$$\hat{LCB} = (Y_t - Y_t^*)'\hat{Q}_1(Y_t - Y_t^*) \qquad (10)$$

$$\hat{Q}_1 = q(p_t)$$

$$\text{and } q(0) = Q_1 , \qquad q(\infty) = Q_2$$

where p_t is the pressure exerted on the bank by the government.

In this framework, the impact of the pressure on the central bank's loss function is embodied in the function q, and implies an altered response of the loss function to deviations from target values for the endogenous variables. That is, as pressure increases, the central bank could in effect be viewed as compromising its unconstrained trade-off weights so as to conform more with those held by the government and in this way alleviate the source of the pressure. In the limit, the observed trade-off weights approach those represented in Q_2.

In analyzing the actual implications of government pressure for the setting of monetary policy, the cyclically adjusted deficit is used as a proxy for this pressure. Here, both the government's feedback rule for the deficit (7) and desired reaction function for monetary policy (8), are functions of the trade-off weights embodied in Q_2, while the unconstrained policy reaction function for the central bank (9) is instead a function of Q_1 from the central bank's own loss function (1). This suggests that an increase in DEF would be associated with an increase in pressure due to its implying an increase in the gap between actual monetary policy and that which would have been set by the government.

Interaction between the set of coefficients in the monetary base and the budget deficit has previously been suggested by Blinder (1983). However, Blinder himself addresses the possible impact of central bank economic goals on deficit accommodation; and deals therefore with the reverse of the direction of causality considered here. At the same time, the common allowance for a continuous role for the constraint imposed by government may be compared to the discrete effect suggested in the model developed by Frey and Schneider (1981) -- whose analysis may be viewed as forming the special case in which there is an infinitely large value for p and discrete switch to the policy preferred by the government.[6]

In any event, with the deficit serving as the proxy for government pressure, we have the deficit now inducing the modification to central bank behavior indicated in the equations above. The general form of the solution for monetary policy becomes

$$\widehat{DMB}_t = \gamma(DEF_t)X_t + \varepsilon_{\gamma D} \tag{11}$$

where γ, rather than being a fixed parameter, is related explicitly to the observed full-employment deficit (with a lag structure corresponding to that of X_t). In this way, the government's loss function now affects monetary policy through the indirect channel provided by the deficit, with corresponding central bank response to the associated government pressure. As specifically shown in Appendix A for the inflation/ unemployment case, the direction of the effect may itself be predicted directly from the relative trade-off weights ascribed to central bank and government.

The nature of the dependence of γ on the deficit is expressed in terms of the simple linear approximation

$$\gamma_t = \gamma_1 + \gamma_2 DEF_t \tag{12}$$

In order to address the influence of the different policy regimes associated with the changing composition of the government, estimation of this framework necessarily requires testing for such structural breaks as those noted in the literature. However, the general form of the approach is in fact found to be most pertinent to the empirical investigation that follows.

3. ESTIMATION RESULTS FOR THE U.S.

In seeking to explain the rate of growth of the monetary base (DMB), the first step is to select a set of variables that might reasonably be expected to feature in the Fed's objective function. Here, the goals of price, interest rate and employment stability are represented by series on the rate of growth of the GNP deflator (DP), the three-month treasury bill rate (TB) and the unemployment rate (UN). Further, the composition of federal spending, as reflected in the rate of growth of real government purchases (DG), is introduced into the model.[7] Following the preceding theoretical analysis, the response to these variables by the Fed is itself taken to be interactive with the deficit. The measure used is the cyclically adjusted series calculated by the Survey of Current Business divided by trend GNP. The equation to be estimated has the form

$$\begin{aligned} DMB_t = \delta_0 &+ \sum_{g=1}^{m} \delta_g DMB_{t-g} + \sum_{h=1}^{n} \kappa_h DEF_{t-h} \\ &+ \sum_{i=1}^{p} (\xi_{i1} + \xi_{i2} DEF_{t-i}) DG_{t-i} \\ &+ \sum_{j=1}^{q} (\tau_{j1} + \tau_{j2} DEF_{t-j}) DP_{t-j} \\ &+ \sum_{k=1}^{r} (\phi_{k1} + \phi_{k2} DEF_{t-k}) TB_{t-k} \\ &+ \sum_{\ell=1}^{s} (\psi_{\ell 1} + \psi_{\ell 2} DEF_{t-\ell}) UN_{t-\ell} + u_t \end{aligned} \tag{13}$$

$$= \delta_0 + \sum_{g=1}^{m} \delta_g DMB_{t-g} + \sum_{h=1}^{n} \kappa_h DEF_{t-h}$$

$$+ \sum_{i=1}^{p} \xi_{i1} DG_{t-i} + \xi_{i2}(DEF \bullet DG)_{t-i}$$

$$+ \sum_{j=1}^{q} \tau_{j1} DP_{t-j} + \tau_{j2}(DEF \bullet DP)_{t-j}$$

$$+ \sum_{k=1}^{r} \phi_{k1} TB_{t-k} + \phi_{k2}(DEF \bullet TB)_{t-k}$$

$$+ \sum_{\ell=1}^{s} \phi_{\ell 1} UN_{t-\ell} + \psi_{\ell 2}(DEF \bullet UN)_{t-\ell} + u_t$$

where additionally included are lagged values of the monetary base and the deficit taken separately. The former allow for evolution of the target values for the economic variables over time -- and in this way may remove the serial correlation that would otherwise be imputed to the error term. The deficit here once again represents the influence of government pressure on central bank policy, with its separate presence representing, *inter alia*, a possible effect on the targets as well as on the response to the economy. It can be seen that the postulated dependence of the feedback rule coefficients on the deficit itself implies that each economic variable be placed alongside a corresponding interaction term in the estimation -- giving a compound variable with a lag structure synonymous with that of the basic economic variable.

However, given that the actual length of the lag structure remains indeterminate from a theoretical perspective,. a test procedure must be used in order to determine the lag lengths m, n, p, q, r and s in equation (13). Here, Akaike (1970) suggests a decision rule that is based on the minimum final prediction error (FPE) criterion. This method is appealing in that it trades-off the risk due to bias when a shorter lag length is selected against risk due to the increase in variance when a higher order is chosen.

In applying the FPE criterion to the model the maximum lag length is set at six. Each variable is then tested in turn, initially holding the lag length on the other variables at the maximum.[8] The estimation itself is over quarterly data from 1961:1 to 1983:4, using OLS. The six quarter limit receives some justification in that in no case does the FPE criterion choose a lag length of more than four for any variable. The significance of the lag lengths selected by the criterion is addressed in Table 1, where the lag length selections are seen to in each case be significant at the one percent level. The results follow in Table 2.[9]

In proceeding toward the interpretation of Table 2, the particular outcome of two tests should be noted. First, the joint significance of the set of interaction terms is confirmed by an F-test:

$F_{9,68} = 5.35 > F^{\text{critical}}_{(0.01)} = 2.68$. In this way, the hypothesized modification of the central bank's response to the economy due to the deficit is indeed supported in the results. Second, allowance is made for a possible reaction by the central bank to international developments -- as encapsulated in the balance of payments deficit and the exchange rate with the U.K. However, when the extra variables are added to the specification, the FPE criterion in each case selects a lag length of zero.

Nevertheless, even without these additions, Table 2 still contains a formidable array of coefficients. Given the dependence of Fed behavior on the deficit as well as the economy, interpretation is necessarily complicated. It is in fact instructive to consider the specific scenarios in which the deficit is assigned values of one standard deviation above and below the mean, together with that of the mean itself. The results of imposing these respective levels for the deficit are given in Table 3.

Focusing on the results for the sum of the lags on each variable, the relevant sign pattern is as listed below:

$$\frac{\partial DMB}{\partial DG} < 0 \qquad \frac{\partial(\partial DMB/\partial DG)}{\partial DEF} > 0 \tag{14}$$

$$\frac{\partial DMB}{\partial DP} < 0 \qquad \frac{\partial(\partial DMB/\partial DP)}{\partial DEF} > 0$$

$$\frac{\partial DMB}{\partial TB} > 0 \qquad \frac{\partial(\partial DMB/\partial TB)}{\partial DEF} < 0$$

$$\frac{\partial DMB}{\partial UN} > 0 \qquad \frac{\partial(\partial DMB/\partial UN)}{\partial DEF} < 0$$

These signs generally suggest a most plausible relationship between the Fed and the administration. At one standard deviation below the mean for the deficit we have, first of all, the negative response to DG that would be expected were the Fed attempting to stabilize the economy by offsetting any stimulus associated with government purchases. Most importantly, the standard precepts of countercyclical policy are satisfied by a contractionary movement of the monetary base in response to inflation, and positive response with respect to TB and UN. There is also a positive effect for the deficit taken separately.

The theoretical analysis implied that fiscal pressure would lead to the countercyclical response being exacerbated for those variables to which the administration attaches a relatively greater weight. Conversely, the response should be damped with respect to an objective such as price stability, which is instead assumed to be of relatively greater concern to the central bank. As the deficit increases, the otherwise negative response to DG is itself almost exactly reversed if we consider the case of one standard deviation above the mean. In this way, administration pressure is seen to induce Fed policy to support rather than offset the movement in government purchases.

The deficit induced effect also operates in the expected direction for DP and TB. The response to DP remains negative over the range considered, but is driven very close to zero as the deficit reaches its upper standard deviation from the mean. This is of course consistent with the postulated effect of the administration's shorter time horizon on the relative emphasis attached to price stability -- and the Fed for its part having to 'bend with the wind' and reduce the size of the contraction that would otherwise follow. The negative interaction effect on TB suggests that the administration also cares less about persistently rising interest rates than does the Fed. This would not imply that the administration <u>wants</u> higher interest rates (and such an event would certainly increase its debt burden), but rather that it attaches <u>relatively</u> less weight to the goal of interest rate stability than does a body whose banking 'constituency' interests must necessarily be closely linked to the state of financial markets.[10]

It is, however, in the effect of the deficit on the response to UN that the results appear somewhat implausible. For instead of the expansionary impetus that would be expected to follow from administration focus on the full employment objective, we instead observe a negative effect. At the same time, though, it should be pointed out that the (one quarter) interaction effect is insignificant at the five percent level, and that the overall response to UN remains well positive even at one standard deviation above the deficit's mean. Therefore, it is possible that the fiscal pressure is directed solely toward accommodation of the deficit and support for government purchases, with indifference toward the effect on stabilization objectives. Alternatively, as with the first quarter (only) interaction effect for DP, this could be weak evidence of a short- lived central bank resistance to monetization -- as suggested in Blinder's (1982) game theoretic analysis, which depicts a Nash equilibrium where the central bank lowers reserves as the government expands the budget deficit.

In any event, the results do certainly appear to offer insight into the full effect of fiscal pressure on stabilization goals. The induced sacrifice of price and interest rate stability is particularly evident

The crucial question remains, however, of whether these results are sensitive to the sample period. Accordingly, the effect of successively excluding each of the presidential administrations in the sample is evaluated using a Chow test for structural change. Test results include those for the Nixon-Ford years taken both jointly and separately -- in view of Hamburger and Zwick's claim that a break coincided with the brief tenure of the Ford administration.

The results are presented in Table 4, and are clearly consistent with continuity over the full sample. It is possible that, in allowing the effect of changes in the deficit over time to be captured in this interactive fashion, the current specification in fact internalizes the apparent source of the instability observed elsewhere. Indeed, application of the same Chow test technique in testing over the tenure of the different Fed chairmen further confirms the stability of the reaction function.[11]

Two further tests, however, are undertaken. First, a potential break coinciding with the transition to floating exchange rates in 1973 is considered. Second, the effect of the October 1979 announced change in Fed operating procedures is addressed. Once again the test statistics are insignificant at the five percent level -- in the latter case concurring with the findings of Hamburger and Zwick (1982), and Hoffman, Low and Reineberg (1983).

Certainly, the apparent robustness of the specification to sample period changes offers valuable support for the model. It derives perhaps from the fact that the model does not impose a separation between the response to the deficit and the response to economic conditions. Rather, it is allowed that the Fed may directly trade off the desirability of satisfying government debt requirements with the desirability of stabilizing economic conditions.

4. CONCLUSIONS

The analysis appears to provide an empirically stable model of monetary policy. Although the role of the deficit is crucial in providing an indirect role for administration policy objectives, isolation of a distinct set of policy objectives on the part of the Fed is also a feature of the results. Support for a relatively greater concern with inflation on the part of the Fed may be compared to the uninhibited 'supply-side' cooperation in producing inflation that is suggested by Toma (1982).[12] Rather, the implied framework is one in which there is a state of persistent tension between the monetary and fiscal authorities. The responsiveness to fiscal pressure itself implies eventual dominance for the administration's preferences, but with central bank preferences also exerting a significant impact on the course of monetary policy. This does of course allow the position of the central bank to extend significantly beyond the 'scapegoat' role attributed to the Fed by Kane (1982). Nevertheless, the postulated scenario remains that of only a very limited form of independence combined with a demonstrable impact of the deficit on the trade-off weights applied in monetary policy.

TABLE 1

Significance of the FPE Selected Lag Lengths

	Lag Length	Test-Statistic	Critical Value (0.05/0.01)
DMB	2	$F_{2,68} = 11.69$	3.13/4.92
DEF	3	$F_{3,68} = 6.45$	2.74/4.08
DG and DEF.DG	2	$F_{4,68} = 3.62$	2.50/3.60
DP and DEF.DP	2	$F_{4,68} = 7.00$	2.50/3.60
TB and DEF.TB	4	$F_{8,68} = 5.39$	2.07/2.77
UN and DEF.UN	1	$F_{2,68} = 5.79$	3.13/4.93

TABLE 2

Results for the FPE Lags

Dependent Variable DMB
Sample 1961:1 - 1983:4

	Coefficient	t-Statistic
Constant	-0.008	(-1.62)
DMB(-1)	0.158	(1.63)
DMB(-2)	0.428	(4.42)
DEF(-1)	0.860	(3.12)
DEF(-2)	-1.080	(-3.79)
DEF(-3)	0.704	(3.14)
DG(-1)	-0.116	(-1.54)
DG(-2)	-0.163	(-1.83)
DEF.DG(-1)	3.240	(0.83)
DEF.DG(-2)	13.651	(3.20)
DP(-1)	0.793	(3.48)
DP(-2)	-1.071	(-4.84)
DEF.DP(-1)	29.590	(-2.50)
DEF.DP(-2)	39.832	(3.19)
TB(-1)	0.015	(0.17)
TB(-2)	-0.231	(-1.98)
TB(-3)	0.496	(5.30)
TB(-4)	-0.153	(-3.42)
DEF.TB(-1)	-4.268	(-1.04)
DEF.TB(-2)	11.559	(2.20)
DEF.TB(-3)	-17.807	(-4.36)
DEF.TB(-4)	2.757	(2.28)
UN(-1)	0.222	(3.30)
DEF.UN(-1)	-4.205	(-1.81)

$\bar{R}^2 = 0.63$ DW = 1.97 $\sigma = 0.004$

TABLE 3

Interpretation of the Results
with Assigned Values for the Deficit

	Deficit at One Standard Deviation Below the Mean (DEF = 0.005)	Deficit at Its Mean Level (DEF = 0.016)	Deficit at One Standard Deviation Above the Mean (DEF = 0.027)
Constant	-0.005	-0.0003	0.005
DMB(-1)	0.158	0.158	0.158
DMB(-2)	0.428	0.428	0.428
DG(-1)	-0.100	-0.064	-0.029
DG(-2)	-0.094	0.056	0.205
DP(-1)	0.643	0.319	-0.004
DP(-2)	-0.869	-0.433	0.002
TB(-1)	-0.007	-0.053	-0.100
TB(-2)	-0.172	-0.046	0.080
TB(-3)	0.406	0.211	0.016
TB(-4)	-0.139	-0.109	-0.079
UN(-1)	0.201	0.155	0.109
ΣDMB	0.586	0.586	0.586
ΣDG	-0.194	-0.008	0.176
ΣDP	-0.226	-0.114	-0.002
ΣTB	0.088	0.003	-0.083
ΣUN	0.201	0.155	0.109

TABLE 4

Stability Over the Different Presidential Administrations

	Test Statistic	Critical Value (0.05)
Kennedy-Johnson excluded (1961:1-1968:4)	$F_{23,46} = 0.60$	1.76
Nixon-Ford excluded (1969:1-1976:4)	$F_{23,46} = 1.19$	1.76
Nixon (only) excluded (1969:1-1974:3)	$F_{23,46} = 1.32$	1.76
Ford (only) excluded (1974:4-1976:4)	$F_{9,60} = 1.55$	2.04
Carter excluded (1977:1-1980:4)	$F_{16,53} = 0.89$	1.84
Reagan excluded (1981:1-1983:4)	$F_{12,57} = 1.24$	1.93

FOOTNOTES

* The material in this paper is adapted from my Ph.D. dissertation entitled "The Interaction of Central Bank Behavior with Fiscal Policymaking and the Political Business Cycle: A Multi-Country Study." (Houston, Tex.: University of Houston), December 1985. I am grateful to Gerald Dwyer, my chairman, and to the other members of my dissertation committee for their guidance throughout the underlying analysis. I would also like to acknowledge helpful comments received from my colleagues at the Federal Reserve Bank of Dallas. The views expressed are those of the author and do not necessarily reflect the positions of the Federal Reserve Bank of Dallas or the Federal Reserve System.

1. A thorough review of the literature on money and deficits is provided by Dwyer (1985).

2. In addressing this literature, Havrilesky (1986a) further points to shifts in monetary policy being specifically related to changes in the political alignment of the government -- with an increase in money supply growth after government changes from conservative to liberal.

3. Related work by Havrilesky (1986b) shows that movements in the narrow money supply can be explained by reference to an index of monetary policy pronouncements by administration officials. This index is a weekly sum of all Wall Street Journal articles over the 1979-1984 period in which administration officials expressed a

desire for easier or tighter monetary policy. The results appear to support the importance of signaling from the administration to the Federal Reserve, with a further finding being that this signaling is itself motivated by changes in economic conditions. Havrilesky does not find evidence of any systematic stabilization policy on the part of the Federal Reserve beyond that indirectly imputed by response to administration signaling, however.

4. The monetary base is an appealing measure of the stance of monetary policy due to its potential applicability across different time periods and across countries. See Lothian (1976) for arguments regarding the relative constancy of the characteristics of high-powered money.

5. The 'Coyne affair' is discussed by O'Brien (1964), pp. 199-201.

6. Frey and Schneider focus on a distinction between two states of the world, described as 'conflict' and 'no conflict' scenarios. It is imposed that in a position of conflict -- which is defined as holding whenever monetary and fiscal policy are seen to be moving in opposing directions -- the government is able to simply 'force' the bank to conform with the slant of fiscal policy. Despite the rather ad hoc nature of this approach, Frey and Schneider do in fact find empirical support for an expansionary stimulus being transmitted to the West German Bundesbank under this so-defined conflict scenario. The Bundesbank's policy instruments meanwhile are seen to exhibit the expected anti-inflationary stance in times of no conflict.

7. This accords with certain optimal public finance considerations raised by Barro (1979); and empirically with the significant role for this variable found by Blinder (1983).

8. In order to correct for the large number of right hand side variables, the initial selections were used as the maxima in a second application of the procedure. This in fact had little effect on the final specification, resulting only in the elimination of the third and fourth lags on DP. (Both of which had a t-statistic below one).

9. For comparison, the results for the FPE criterion were in fact supplemented by those for the alternative C_p-statistic described by Mallows (1973). Here the lag length selections were in fact identical with respect to the included variables, but with the C_p criterion at the same time excluding completely DMB, and DG and DEF.DG. Given that the actual significance of the latter variables is clearly demonstrated in Table 1, it appears that the more generous FPE selections are indeed the more appropiate. (Results for the C_p lags may be found in chapter three of my dissertation).

10. The importance to the Fed of support from its banking constituency has been stressed both by Skaggs and Wasserkrug (1983) and by Friedman (1982).

11. It may be noted that the interactive role for the deficit was also found to be constant accross presidential elections. That is, only in the case of the 1972 election was there even weak significance of an election dummy -- whether defined over the full year preceding

each election or just over the second and third quarters of the election year. Further allowance for a shift in the interaction terms prior to presidential elections -- and hence for an indirect electoral cycle in monetary policy of the type suggested by Laney and Willett (1983) -- also met with negative results. The present findings may in fact be set against those of Allen (1986), whose results indicate a significant interaction between the electoral cycle and the change in outstanding government debt. Allen's approach does not allow for any additional interaction between the fiscal measure and Federal Reserve response to stabilization objectives, however.

12. This is not to deny Toma's argument that pursuit of discretionary profits provides an incentive for Fed officials to push money creation to the point where there is maximum wealth-transfer from the general public. However, unless other factors such as reputation and support of the banking sector are given a zero utility weight, the rationale for a greater concern with price-stability on the part of the central bank would seem to remain pertinent. This indeed concords with conclusions drawn in studies such as that of Woolley (1977, p. 156), who states: "The concern which unites virtually all central bankers is their opposition to inflation."

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APPENDIX A

In this appendix, the effect of an increase in pressure on the feedback rule is calculated explicitly. A function that has the general properties indicated in (10) in the main text is defined as

$$\hat{Q}_1 = Q_1\, e^{-p} + Q_2\, e^{-(1/p)} \tag{A1}$$

where $\hat{Q}_1$ is an N × N matrix

p is a scalar.

Here, the derivative of the loss function with respect to pressure can be calculated to be

$$\begin{aligned} \frac{\partial L\hat{C}B}{\partial p} &= \frac{\partial}{\partial p} (Y_t - Y_t^*)'\hat{Q}_1(Y_t - Y_t^*) \\ &= (Y_t - Y_t^*)'(-Q_1\, e^{-p} + (1/p^2)Q_2\, e^{-(1/p)}) \\ &\quad \times (Q_1\, e^{-p} + Q_2\, e^{-(1/p)})(Y_t - Y_t^*) \end{aligned} \tag{A2}$$

Equation (A2) may be rewritten as

$$\frac{\partial L\hat{C}B}{\partial p} = (Y_t - Y_t^*)'R\hat{Q}_1(Y_t - Y^*{}_t) \tag{A3}$$

where $R = -Q_1 e^{-p} + (1/p^2)Q_2\, e^{-(1/p)}$

and R is an N × N matrix.

It is the case that we have the expected sign of $\partial L\hat{CB}/\partial p > 0$ if R is positive definite. That is, with $\hat{Q}_1$ positive definite, $R\hat{Q}_1$ is then the product of two positive definite matrices -- and such a product is itself positive definite (Graybill, 1983, p. 227). For $p \geq 1$, this condition on R is satisfied under the assumption that Q_2 is large relative to Q_1. The importance of government pressure for central bank behavior is now examined in detail in the analysis below.

The nature of the solution for the central bank's optimal strategy can in fact be obtained as illustrated for the case of equation (4) in the text. The constraint represented by the structure of the economy is as set-out in equation (3). Here the closed loop rule for monetary policy, given the explicit form of the extended loss function (A1), becomes

$$D\hat{M}B_t = FX_t + GY_t^* \tag{A4}$$

where $F = -(A'\hat{Q}_1A)^{-1}A'\hat{Q}_1B$

$$= -(A'[Q_1\ e^{-p} + Q_2\ e^{-(1/p)}]A)^{-1}A'[Q_1\ e^{-p} + Q_2\ e^{-(1/p)}]B$$

$$G = (A'\hat{Q}_1A)^{-1}A'\hat{Q}_1$$

$$= (A'[Q_1\ e^{-p} + Q_2\ e^{-(1/p)}]A)^{-1}A'[Q_1\ e^{-p} + Q_2\ e^{-(1/p)}]\ .$$

With GY_t^* treated as before, we have

$$\hat{DMB}_t = FX_t + \varepsilon_F \qquad \text{(A5)}$$

Evaluation of an effect in pressure on the feedback rule requires determination of the derivatives $\partial F/\partial p$ and $\partial^2 F/\partial p^2$. In view of the complex nature of the system matrices, these derivatives are in fact represented for the most simple case of two targets and one policy instrument. Here we consider the response of the monetary base (DMB) to lagged values of x_i and of x_j -- which for expositional purposes are allowed to stand for inflation and unemployment respectively.

Let

$$A = \begin{bmatrix} a_i \\ a_j \end{bmatrix} \qquad B = \begin{bmatrix} b_i & 0 \\ 0 & b_j \end{bmatrix} \qquad \text{(A6)}$$

$$Q_1 = \begin{bmatrix} q_{1i} & 0 \\ 0 & q_{1j} \end{bmatrix} \qquad Q_2 = \begin{bmatrix} q_{2i} & 0 \\ 0 & q_{2j} \end{bmatrix}$$

$$W_t = [\hat{DMB}] \qquad X_t = \begin{bmatrix} x_i \\ x_j \end{bmatrix} \qquad Y_t = \begin{bmatrix} y_i \\ y_j \end{bmatrix}$$

Here

$$F = (e^{-p}(a_i{}^2 q_{1i} + a_j{}^2 q_{1j}) + e^{-(1/p)}(a_i{}^2 q_{2i} + a_j{}^2 q_{2j}))^{-1} \tag{A7}$$

$$\times\ (e^{-p}[a_i b_i q_{1i} \quad a_j b_j q_{1j}] + e^{-(1/p)}[a_i b_i q_{2i} \quad a_j b_j q_{2j}]$$

$$= \frac{-1}{(a_i{}^2 q_{1i} + a_j{}^2 q_{1j}) + e^{(p^2-1/p)}(a_i{}^2 q_{2i} + a_j{}^2 q_{2j})}[a_i b_i q_{1i} \quad a_j b_j q_{1j}]$$

$$- \frac{1}{e^{-(p^2-1/p)}(a_i{}^2 q_{1i} + a_j{}^2 q_{1j}) + (a_i{}^2 q_{2i} + a_j{}^2 q_{2j})}[a_i b_i q_{2i} \quad a_j b_j q_{2j}]$$

Where there is no pressure being exerted by the government we find

$$\left.\frac{\partial \hat{DMB}}{\partial x_i}\right|_{\substack{x_j = \text{constant} \\ p = 0}} = \frac{-a_i b_i q_{1i}}{a_i{}^2 q_{1i} + a_j{}^2 q_{1j}} < 0 \tag{A8}$$

and

$$\left.\frac{\partial \hat{DMB}}{\partial x_j}\right|_{\substack{x_i = \text{constant} \\ p = 0}} = \frac{-a_j b_j q_{1j}}{a_i{}^2 q_{1i} + a_j{}^2 q_{1j}} > 0 \tag{A9}$$

with the following assumptions:

For x_i as inflation -- $a_i > 0$, $b_i > 0$, $q_{1i} > 0$.

For x_j as unemployment -- $a_j < 0$, $b_j > 0$, $q_{1j} > 0$.

The assumptions on a_i and a_j reflect the premise that an increase in the growth rate of the monetary base increases the inflation rate relative to the target level ($a_i > 0$), but decreases the unemployment rate ($a_j < 0$). The further assumptions allow for a positive relationship between current levels of the target variables and their past values (b_i, $b_j > 0$), and for the loss function to be increasing in both inflation and unemployment (q_{1i}, $q_{1j} > 0$).

The response of the feedback rule to pressure itself depends upon the derivative $\partial F/\partial p$. This is given by

$$\partial F/\partial p = J[a_i b_i q_{1i} \quad a_j b_j q_{1j}] - K[a_i b_i q_{2i} \quad a_j b_j q_{2j}] \tag{A10}$$

where

$$J = \frac{(p^2 + 1/p^2)e^{(p^2-1/p)}(a_i{}^2 q_{2i} + a_j{}^2 q_{2j})}{((a_i{}^2 q_{1i} + a_j{}^2 q_{1j}) + e^{(p^2-1/p)}(a_i{}^2 q_{2i} + a_j{}^2 q_{2j}))^2}$$

$$K = \frac{(p^2 + 1/p^2)e^{-(p^2-1/p)}(a_i{}^2 q_{1i} + a_j{}^2 q_{1j})}{(e^{-(p^2-1/p)}(a_i{}^2 q_{1i} + a_j{}^2 q_{1j}) + (a_i{}^2 q_{2i} + a_j{}^2 q_{2j}))^2}$$

and $J > 0$, $K > 0$ (by inspection).

The implications of (A10) for the behavior of the monetary base may be seen as follows:

$$\left.\frac{\partial(\partial \widehat{DMB}/\partial x_i)}{\partial p}\right|_{x_j = \text{constant}} = J[a_i b_i q_{1i}] - K[a_i b_i q_{2i}] > 0 \tag{A11}$$

$$\left.\frac{\partial(\partial \hat{DMB}/\partial x_j)}{\partial p}\right|_{x_i = \text{constant}} = J[a_j b_j q_{1j}] - K[a_j b_j q_{2j}] > 0 \qquad \text{(A12)}$$

where, in addition to the earlier assumptions, it is further imposed that $q_{1i}/q_{2i} > K/J > q_{1j}/q_{2j}$.

This condition has the central bank attaching a relatively greater weight to inflation than the government, with the government in its turn placing a relatively greater weight on unemployment. (As would be indicated by the longer time horizon that has been attributed to the central bank.) Provided that (K/J) is in fact bounded by the respective relative weights attached to inflation and unemployment, this then implies that pressure leads to the response of the monetary base to both variables being more expansionary than it otherwise would have been. In the case of inflation, this does not mean that the observed movement in the monetary base cannot still be contractionary -- rather that, at the very least, the contraction will be less than that predicted by (A8) for the unconstrained case. Certainly, it can be seen that the (intuitively plausible) assumptions about the trade-off weights lead directly into testable hypotheses regarding the pattern of central bank behavior. Furthermore, it may be noted that (in contrast to (A8) and (A9)) the trade-off weights of the government now appear in the solution alongside those of the central bank. As pressure is increased, the former are seen to increasingly dominate the response pattern embodied in the feedback rule.

However, it would be expected that the response to the pressure might be decreasing in p. That is, we have the modification to the feedback rule becoming incrementally smaller as the outcome approaches that consistent with the trade-off weights of the government (Q_2). This gradual convergence of the feedback rule to the government- preferred outcome requires $\partial^2 F/\partial p^2 < 0$. We find

$$\frac{\partial^2 F}{\partial p^2} = M[a_i b_i q_{1i} \quad a_j b_j q_{1j}] + N[a_i b_i q_{2i} \quad a_j b_j q_{2j}] \tag{A13}$$

where

$$M = \frac{m}{((a_i^2 q_{1i} + a_j^2 q_{1j}) + e^{(p^2-1/p)}(a_i^2 q_{2i} + a_j^2 q_{2j}))^3}$$

$$N = \frac{n}{(e^{-(p^2-1/p)}(a_i^2 q_{1i} + a_j^2 q_{1j}) + (a_i^2 q_{2i} + a_j^2 q_{2j}))^3}$$

$$m = \left[\left(\frac{p^2 + 1}{p^2}\right)^2 e^{2(p^2-1/p)}(a_i^2 q_{2i} + a_j^2 q_{2j})^2 \right]$$

$$\times \left[e^{-(p^2-1/p)}\left(\frac{a_i^2 q_{1i} + a_j^2 q_{1j}}{a_i^2 q_{2i} + a_j^2 q_{2j}}\right)\left(1 - \left(\frac{p}{p^2 + 1}\right)\left(\frac{2}{p^2 + 1}\right)\right) - \left(1 + \left(\frac{p}{p^2 + 1}\right)\left(\frac{2}{p^2 + 1}\right)\right) \right]$$

$$n = \left[\left(\frac{p^2 + 1}{p^2}\right)^2 e^{-2(p^2 - 1/p)} (a_i{}^2 q_{1i} + a_j{}^2 q_{1j})^2 \right]$$

$$\times \left[e^{(p^2 - 1/p)} \left(\frac{a_i{}^2 q_{2i} + a_j{}^2 q_{2j}}{a_i{}^2 q_{1i} + a_j{}^2 q_{1j}}\right)\left(1 - \left(\frac{p}{p^2 + 1}\right)\left(\frac{2}{p^2 + 1}\right)\right) - \left(3 + \left(\frac{p}{p^2 + 1}\right)\left(\frac{2}{p^2 + 1}\right)\right) \right]$$

and $M \lessdot 0$, $N \gtrdot 0$ (with the sign on M being unambiguously negative if $(q_{2i} + q_{2j}) \geqslant (q_{1i} + q_{1j})$ -- itself implied under (A3).

Applying this yields

$$\left.\frac{\partial^2(\partial \hat{DMB}/\partial x_i)}{\partial p^2}\right|_{x_j = \text{constant}} = M[a_i b_i q_{1i}] - N[a_i b_i q_{2i}] < 0 \qquad \text{(A14)}$$

$$\left.\frac{\partial^2(\partial \hat{DMB}/\partial x_j)}{\partial p^2}\right|_{x_i = \text{constant}} = M[a_j b_j q_{1j}] - N[a_j b_j q_{2j}] < 0 \qquad \text{(A15)}$$

with the earlier assumptions under (A11) and (A12) above, and for the equivalent condition $q_{1i}/q_{2i} > |N/M| > q_{1j}/q_{2j}$.

The explicit solutions certainly appear to accord with the properties ascribed to the generalized loss function (10) in the main text. It is indeed shown that, as pressure increases, the unconstrained policy response (as given in (A8) and (A9)) becomes increasingly compromised -- with assumptions regarding the relative trade-off weights leading directly to implications regarding the direction of the effect on the monetary base. Although the analysis has been confined to the scenario with two targets and one instrument, it is apparent that the general case can be viewed as being analogous -- so long as the number of targets always exceed the number of instruments.

APPENDIX B

U.S. Data Sources and Definitions

All data series are obtained from Citibase -- with the exception of TRNDGNP which is taken from de Leeuw and Holloway (1983).

DMB = log(MBASE/MBASE(-1))

where MBASE is the monetary base adjusted for reserve requirement changes by the Federal Reserve Bank of St. Louis (end of quarter figures).

DEF = (-1 x BUDGET)/TRNDGNP

where BUDGET is the cyclically adjusted federal budget, TRNDGNP is (middle expansion) trend GNP.

DG = log(GOV/GOV(-1))

where GOV is real federal government purchases (in 1972 dollars).

DP = log(PRICE/PRICE(-1))

where PRICE is the GNP deflator (1972 = 100)

UN is the unemployment rate.

TB is the three-month treasury bill rate.

All series with the exception of TB are seasonally adjusted at source.