The Short Run Impact of Fiscal Policy on the Money Supply*

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I. Introduction

Surprisingly little research effort has been devoted to the study of the impact of fiscal variables on the money supply. Furthermore, the limited amount of empirical evidence is often ambiguous and contradictory. Both Froyen [10] and Barro [1] find some evidence of a positive relationship between fiscal expansion and either the money supply or a monetary policy variable, implying that the monetary authorities tend to accommodate fiscal policy. Some evidence of a negative relationship is found in studies by Wood [27], Friedlaender [9], Gordon [13], and Cacy [3]. This implies that monetary actions tend to offset, rather than accommodate, expansionary fiscal actions.

The absence of stronger empirical support for a positive fiscal policy-money supply relationship seems surprising in view of the frequently heard argument—often associated with the monetarists, as in Fand [6] and Buchanan and Wagner [2]—that large fiscal deficits typically result in substantial increases in the monetary aggregates. Exactly how this process is supposed to work is not always clear, but perhaps a typical explanation is outlined by Francis [8]. The Federal Reserve is seen as having an over-riding concern with stabilizing interest rates, so that fiscal expansion leads more or less mechanically to an increase in the money supply. An expansionary fiscal policy action results in a budget deficit which must be financed through issuance of government securities; the sale of these securities to the private sector puts upward pressure on market interest rates; this upward pressure is countered by Federal Reserve purchases of outstanding government securities, thereby monetizing, at least in part, the debt issued to finance the deficit.

But to consider interest rate stabilization—or financial market stability—as the single goal of the Federal Reserve would clearly be extreme. Previous studies which have estimated policy reaction functions for the Federal Reserve—including those of Wood [27], Friedlaen-

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der [9], and Froyen [10]—have concluded that Federal Reserve policy actions reflect a significant concern for a variety of macroeconomic stabilization goals as well as the financial market stability goal.[1] Given other goals, the monetary accommodation of fiscal policy is hardly obvious. To cite one simple example, assume that the Federal Reserve has two concerns—interest rate stabilization and the inflation rate. Expansionary fiscal policy action will tend to raise both the inflation rate and the interest rate. If Federal Reserve concern with inflation is sufficiently greater than its concern with interest rate stabilization, it will take action to offset, rather than accommodate, the fiscal expansion. Analysis of the fiscal-monetary policy relationship is thus complicated by consideration of multiple goals for the Federal Reserve.

Actually, the problem is even more complex since the effect of fiscal policy on the monetary policy variable represents only one channel by which fiscal policy can affect the money supply. That is, fiscal policy, by changing such variables as income and interest rates, affects private sector behavior, which in turn affects the money supply. For this reason, it is instructive to consider two cases, one in which the Federal Reserve is considered exogenous and the second in which the Federal Reserve is made endogenous.

II. Description and Estimation of the Model

In this paper we estimate a linear variant of the IS-LM model that incorporates endogenous taxes, a wealth variable, and inflationary expectations. The narrow definition of the money supply is utilized. Unborrowed reserves (adjusted for changes in reserve requirements) are used as the monetary policy variable. In Case I Federal Reserve behavior is treated as exogenous so that the effect of fiscal policy on the money supply is due entirely to private sector response. In Case II the Federal Reserve is made endogenous by incorporating a reaction function into the IS-LM model, so the effect of fiscal policy on the money supply is due to both private and Federal Reserve response. The effects of fiscal variables on the money supply for both cases are estimated by solving the structural model for the reduced form money supply equations and examining the fiscal variable coefficients in these equations.

The estimates of the structural parameters of the model and the identities are presented in Table I. Definitions of the variables are provided in Table II. The model is estimated by iterative three-stage least squares from seasonally adjusted quarterly data beginning in 1953:01 and ending in 1976:04.[2] This sample period was selected since it spans three presi-

1. See, also T. Havrilesky [15]; M. W. Keran and C. T. Babb [17]; and T. Havrilesky, R. M. Sapp, and R. L. Schweitzer [16].

2. The estimation package used is the SAS package. The data were corrected for autocorrelation before the system was estimated by three-stage least squares. Initial consistent estimates of the autocorrelation coefficients were obtained by the technique described in Fair [5]. The data were then adjusted by the technique described in Pindyck and Rubinfeld [23].

The model was estimated both with and without the reaction function as a structural equation. However, since there were no statistically significant differences in the coefficients of the equations common to both estimations, only the model with the reaction function is presented in the paper. This result is similar to the finding of Goldfeld and Blinder [12] of no serious estimation biases when the reaction function is excluded from the model.

The Durbin-Watson statistics are not presented since they are unreliable indicators of autocorrelation in the presence of lagged dependent variables.

Considerable experimentation with alternative lag schemes led to the adoption of the implicit Koyck lag structure in a number of the equations. Other equations have no lagged terms as explanatory variables since similar lag structures did not improve their fit. It should be noted that the lag patterns experimented with were restricted by the characteristics of the three-stage least squares estimation package utilized in this study. Specifically, the package could not accommodate polynomial lag structures.

Table I

Product Sector

1) $Y_t = C_t + I_t + G_t^F + G_t^{SL} + E_t - IM_t$ (Equilibrium Condition)

2) $C_t = \underset{(-3.81)}{-11.78} + \underset{(3.07)}{.214}\, YD_t + \underset{(3.36)}{.019}\, WE_{t-1} + \underset{(9.70)}{.777}\, C_{t-1}$ $\bar{R}^2 = .999$ (Consumption Function)

3) $YD_t = Y_t - KCA_t - T_t^{SL} - T_t^{F,EN} - T_t^{F,EX}$ (Disposable Income Definition)

4) $WE_t = \underset{(10.49)}{615.70} - \underset{(-3.72)}{94.01}\, i_t^{\ell} + \underset{(6.71)}{.615}\, Y_t$ $\bar{R}^2 = .785$ (Wealth Function)

5) $I_t = \underset{(2.99)}{8.99} - \underset{(-1.49)}{2.20}\, i_{t-2}^{\ell} + \underset{(2.81)}{.233}\, dY_{t-1} + \underset{(5.38)}{.049}\, Y_t + \underset{(13.36)}{.668}\, I_{t-1}$ $\bar{R}^2 = .986$ (Investment Function)

6) $IM_t = \underset{(-2.51)}{-4.41} + \underset{(3.00)}{.014}\, Y_t + \underset{(19.72)}{.896}\, IM_{t-1}$ $\bar{R}^2 = .985$ (Import Function)

Monetary Sector

7) $M_t^D = M_t^S$ (Equilibrium Condition)

8) $i_t^m = \underset{(4.57)}{10.16} - \underset{(-3.97)}{.115}\, M_t^D + \underset{(4.29)}{.017}\, Y_t + \underset{(7.67)}{.636}\, \dot{P}_t^E$ $\bar{R}^2 = .668$ (Inverse Money Demand Function)

9) $M_t^S = \underset{(8.13)}{34.11} + \underset{(5.17)}{3.24}\, [i_t^m - i_t^{DS}] + \underset{(42.60)}{7.41}\, UBR_t$ $\bar{R}^2 = .948$ (Money Supply Function)

10) $UBR_t = \underset{(4.75)}{3.86} + \underset{(2.67)}{.022}\, G_t^F - \underset{(-2.38)}{.029}\, T_t^{F,EX} + \underset{(16.54)}{.016}\, Y_{t-1} + \underset{(3.03)}{.005}\, RYH_t - \underset{(-.81)}{.0002}\, IDRYH$ $\bar{R}^2 = .998$ (Federal Reserve Reaction Function)

$\underset{(-1.65)}{-.0006}\, IRRYH - \underset{(-11.19)}{.576}\, i_{t-1}^m + \underset{(1.72)}{.059}\, IRTBL - \underset{(-.01)}{.001}\, \dot{P}_t^D + \underset{(1.84)}{.247}\, IIDEMO$

$+ \underset{(2.54)}{.231}\, IIREP2 + \underset{(.55)}{.066}\, GP + \underset{(1.39)}{.251}\, WPC + \underset{(1.57)}{.290}\, WPCAF$

11) $i_t^{\ell} = \underset{(4.13)}{.348} + \underset{(2.29)}{.039}\, i_t^m + \underset{(4.41)}{.0006}\, Y_t + \underset{(18.59)}{.794}\, i_{t-1}^{\ell}$ $\bar{R}^2 = .983$ (Term Structure Function)

Price Sector

12) $\dot{P}_t = \underset{(2.08)}{.591} - \underset{(-4.25)}{.059}\, RAD_t + \underset{(11.18)}{.884}\, \dot{P}_t^E + \underset{(.29)}{.108}\, GP - \underset{(-1.49)}{.792}\, WPC + \underset{(4.30)}{2.33}\, WPCAF$ $\bar{R}^2 = .748$ (Inflation Function)

t – statistics are reported in parentheses dential regimes of eight consecutive years and enables us to test the hypothesis that Federal Reserve policies vary with changes in political attitudes toward economic policy.

A brief discussion of several aspects of the individual equations is in order. All coefficients (with the exceptions of $\dot{P}_t^D$ in equation 10 and *GP* in equation 12) are of the expected sign and the adjusted R^2's indicate a reasonably good fit to the data. Only a few variables are not statistically significant at the 5% level; of these most are significant at the 10% level.[3]

For our purposes, it is important to consider exogenous fiscal variables. While federal government expenditures on goods and services are assumed to be exogenous, it is necessary to separate federal net taxes into an exogenous and endogenous component. These two components are calculated as follows: endogenous receipts ($T^{F,EN}$) $= r^A_{t-1}Y_t$ and exogenous receipts ($T^{F,EX}$) $= Y_{t-1}dr^A_t$, where $r^A_t = (r_t + r_{t-1} + r_{t-2} + r_{t-3})/4$ and $dr^A_t = r^A_t - r^A_{t-1}$.[4]

Wealth is measured as the summation of the monetary base (*MB*), the discounted value of net dividend payments to the public (*KSTK*), and the discounted value of interest payments on federal debt (*VGS*), which is treated for simplicity as consisting solely of consols.[5] Wealth is treated in the model as an endogenous variable being related to Y_t and i_t^l. It is assumed that Y_t is a reasonable proxy for DIV_t and $INTG_t$. An increase in DIV_t and $INTG_t$, ceteris paribus, leads to an increase in wealth. An increase in MB_t, even though the value of government securities held by the public falls by the same amount, leads to an increase in wealth by reducing market interest rates and thereby increasing the discounted value of DIV_t and $INTG_t$. Thus, as expected, the coefficient on Y_t in equation 4 is positive and statistically significant. Also as expected, since an increase in market interest rates, ceteris paribus, lowers the discounted value of DIV_t and $INTG_t$, the coefficient on i_t^l in the wealth equation is negative and is statistically significant.

Although the budget constraints of the monetary and fiscal authorities do not explicitly appear in the model, their effects upon wealth appear implicitly through their impact on the explanatory variables in the wealth equation. For example, assuming for simplicity an initially balanced budget, an increase in government expenditures leads to a deficit. The deficit requires issuance of more government securities which, ceteris paribus, tends to increase wealth, but the financing of the deficit tends to raise market interest rates which, ceteris pa-

3. The following variables were significant at the 10% level: i_{t-2}^l (equation 5), *WPC* (equations 10 and 12), and *WPCAF* (equation 10). Ignoring the reaction function (which is discussed in the body of the paper), the only variable not statistically significant is *GP* in equation 12.

4. Beginning with a tax function, $T = rY$, $dT \approx r_{t-1}dY_t + Y_{t-1}dr_t$. The first term represents endogenous tax receipts—the change in net tax receipts when r_{t-1} is unchanged but Y changes. The second term appears to combine two effects on tax receipts—the effect of a change in economic activity on the average tax rate and the effect of a discretionary change in tax rates on tax receipts. However, since an ordinary least square regression of dr_t on Y_t revealed no systematic variation in dr_t, all changes in r were considered discretionary.

Utilizing the equation $T_t = T_{t-1} + dT_t$ and substituting from the total differential and rearranging, we obtain $T_t = r_{t-1}Y_t + Y_{t-1}dr_t$. The first and second terms, respectively, can be used to generate a time series for endogenous and exogenous tax receipts. However, one problem that emerges stems from the exaggerated effect of a temporary change in net tax receipts in one quarter (e.g., from a temporary rebate) on the tax rate for subsequent quarters. To reduce this exaggerated effect, a technique of smoothing changes in the calculated rate was introduced, thus resulting in the equations shown in the text. The resulting time series are smoother than the initial series and the change in exogenous receipts is generally in the same direction as announced changes in tax policy.

5. Explicitly, $KSTK_t = DIV_t/i_t^l$ where DIV_t = value of net dividend payments to the private sector and i_t^l = current value of the long term interest rate. $VGS_t = INTG_t/WDR_t$ where $INTG_t$ = total interest payments on federal government debt held by the private sector and WDR_t = a weighted discount rate. The weighted discount rate is the weighted sum of the current period short and long term interest rates where the weight on the long term rate is the proportion of long term debt in the total federal debt and the weight on the short term rate is one minus the weight on the long term rate. This weighting scheme thus results in all intermediate term debt being treated as short term debt.

Table II. Definition of Variables

Y_t	= nominal GNP, period t.
C_t	= nominal consumption expenditures, period t.
C_{t-1}	= nominal consumption expenditures, period t-1.
I_t	= nominal investment expenditures, period t.
I_{t-1}	= nominal investment expenditures, period t-1.
G_t^F	= nominal federal government expenditures on goods and services, period t.
G_t^{SL}	= nominal state and local government expenditures on goods and services, period t.
E_t	= nominal exports, period t.
IM_t	= nominal imports, period t.
IM_{t-1}	= nominal imports, period t-1.
YD_t	= nominal disposable income, period t.
WE_t	= nominal net wealth, period t.
KCA_t	= nominal value of capital consumption allowance, period t.
T_t^{SL}	= nominal state and local net tax receipts, period t.
$T_t^{F,EN}$	= nominal endogenous federal net tax receipts, period t.
$T_t^{F,EX}$	= nominal exogenous federal net tax receipts, period t.
i_t^m	= short-term interest rate (3-month Treasury bill rate), period t.
i_{t-1}^m	= short-term interest rate (3-month Treasury bill rate), period t-1.
i_t^ℓ	= long-term interest rate (long-term federal government bond rate), period t.

ribus, tends to reduce wealth. Both effects are captured in our model. The increased government expenditures tends to raise aggregate demand and output directly and to induce increases in consumption and investment expenditure within the same quarter; the increase in Y_t tends to increase WE_t. At the same time, the increase in Y_t tends to raise both short term and long term interest rates and thereby reduce WE_t (see Table I, equations 4, 8, and 11). Evidence on whether the depressing effect on wealth offsets the stimulatory effect within the same quarter can be obtained by examining the reduced form equation for wealth. The re-

i^{ℓ}_{t-1} = long-term interest rate (long-term federal government bond rate), period t-1.

i^{ℓ}_{t-2} = long-term interest rate (long-term federal government bond rate), period t-2.

dY_{t-1} = change in nominal income from period t-2 to t-1.

M^D_t = nominal money demand, period t.

M^S_t = nominal money supply, period t.

$\dot{P}^E_t$ = anticipated rate of inflation, period t.

i^{DS}_t = Federal Reserve discount rate, period t.

UBR_t = nominal unborrowed reserves adjusted for reserve requirement changes, period t.

RYH_t = real high-employment output, period t.

IDRYH = interaction dummy variable for RYH and Kennedy-Johnson administration.

IRRYH = interaction dummy variable for RYH and Nixon-Ford administration.

IRTBL = interaction dummy variable for the desired short-term interest rate.

$\dot{P}^D_t$ = Federal Reserve desired rate of inflation, period t.

IIDEMO = interaction dummy variable for $\dot{P}^D_t$ and Kennedy-Johnson administration.

IIREP2 = interaction dummy variable for $\dot{P}^D_t$ and Nixon-Ford administration.

WPC = wage and price freeze dummy variable.

WPCAF = post-freeze wage and price control dummy variable.

GP = guidepost dummy variable.

$\dot{P}_t$ = actual rate of inflation, period t.

RAD_t = aggregate demand proxy, period t.

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duced form equation for WE_t for both Cases I and II suggests that these same quarter effects are expansionary.[6]

The Federal Reserve's major policy tools are reflected directly or indirectly in the money supply equation (equation 9). Unborrowed reserves are adjusted for reserve require-

6. For Case I, the coefficients on G_t^F and $T_t^{F,EX}$ in the reduced form for WE_t are .684 and −.146, respectively; for Case II the coefficients are .732 and −.218, respectively.

ment changes and the difference between the short-term interest rate and the Federal Reserve's discount rate is used as a second explanatory variable. Both coefficients are of the expected sign and statistically significant.

A price expectations variable is included in both the inverse money demand function—the short-term interest rate equation (equation 8)[7]—and the inflation equation (equation 12). This variable is calculated from an autoregression of the current inflation rate on past rates of inflation. Both straight lag structures (regressing $\dot{P}^t$ on $\sum_{i=0}^{n} \dot{P}_{t-i-1}$ with various values for n) and polynomial lag structures were estimated. The best fit was found for the following straight lag structure: $\dot{P}_t^E = .43\ \dot{P}_{t-1} + .18\ \dot{P}_{t-2} + .28\ \dot{P}_{t-3}$, thus implying that economic units form their expectations of inflation based upon the inflation rates for the past three quarters.[8]

The inflation equation contains the price expectations variable ($\dot{P}_t^E$), an aggregate demand variable (RAD_t), and dummy variables for guideposts (GP) and wage and price controls (WPC and $WPCAF$).[9] The aggregate demand variable is similar to one employed by Gordon [13] in a study of inflation, and is defined as

$$RAD_t = [((YH_t - Y_t)/YH_t) - ((YH_{t-1} - Y_{t-1})/YH_{t-1})]/[(YH_{t-1} - Y_{t-1})/YH_{t-1}]$$

where YH_t = nominal high employment GNP in the current period.[10] This variable represents the proportional rate of change in the GNP gap. One would expect an increase in RAD_t to reduce $\dot{P}_t$ since the pressure of aggregate demand on capacity is reduced. As expected, the coefficient on RAD_t is negative and statistically significant.[11]

7. The money demand function underlying this equation thus contains both i_t^m and $\dot{P}_t^E$ as separate explanatory variables. Although nominal interest rates reflect in part anticipated inflation, many empirical studies have found that anticipated inflation affects interest rates with a coefficient of less than one. See Laidler and Parkin [18] and the studies referenced therein. For examples of studies that have employed anticipated inflation as an explanatory variable in the money demand function, see Goldfeld [11], Shapiro [25], and Melitz [20].

Money demand functions often employ the money stock lagged one period as an explanatory variable to capture partial adjustment to the desired level of money holdings. The inverse money demand function was estimated with the lagged money stock as an additional explanatory variable. However, a general linear test of the significance of the coefficient on this variable led to nonrejection of the null hypothesis that the coefficient was equal to zero. For a description of the general linear test (F – test) see Neter and Wasserman [22, 264].

8. Lag structures of longer length—both straight and polynomial—were characterized by sign reversals on lags beyond t–3.

An alternative technique was also tested. This technique was suggested by Toyoda [26] and is based upon an adaptive expectations model. The specific model employed is: $\dot{P}_t^E - \dot{P}_{t-1}^E = E(\dot{P}_{t-1} - \dot{P}_{t-1}^E)$. This model states that the change in the expected rate of inflation is a function of the discrepancy between the actual and expected inflation rates in the previous period. E is an adjustment coefficient which shows the rate of adjustment to this discrepancy. Rearranging this equation we find: $\dot{P}_t^E = E\dot{P}_{t-1} + (1 - E)\dot{P}_{t-1}^E$. Time series for $\dot{P}_t^E$ can now be constructed by employing the actual inflation series, assuming a particular value for E, assuming a starting value for $\dot{P}_{t-1}^E$ and then recursively solving the equation. Ten series were generated by using values of E from .1 to 1 in increments of .1 and by assuming an initial expected inflation rate of 0. These ten time series were employed in the short-term interest rate and inflation rate equations as measures of $\dot{P}_t^E$. However, estimation of the entire system of equations for each time series measure of $\dot{P}^E$ resulted in equations that had a poorer fit and that often had the opposite sign of the estimated parameters presented in Table I.

9. Initially, the inflation equation included the inverse of the total unemployment rate and an aggregate demand variable as separate explanatory variables. Considerable experimentation with various forms of this equation, however, led to the elimination of the unemployment rate. The unemployment rate variable consistently had the opposite of the anticipated sign, whether employed alone or with the aggregate demand variable, and whether only the current period value or the current period value and lagged values were used.

10. Nominal high employment GNP (YH_t) is constructed by multiplying real high employment GNP in period t by the actual GNP price deflator in period t.

11. Other aggregate demand variables were employed both singly and in conjunction with RAD_t. These variables included $[(YH_t - Y_t)/YH_t]$, $[(YH_{t-1} - Y_{t-1})/YH_{t-1}]$, and (Y_t/YH_t). Equations with various lag structures on these variables were also estimated. However, the best fitting equation in terms of the match between estimated and anticipated coefficient signs and in terms of statistically significant coefficients on the aggregate demand variable (s) was the equation containing only RAD_t as the aggregate demand variable.

The three dummy variables in the inflation equation have values of 1 for the period covered and 0 for all other periods: the guidepost dummy covers the period 1963:1 to 1966:2; the first wage and price control dummy covers the period of price freeze, 1971:3 to 1972:4, and, following Gordon [14], the second wage and price control dummy covers the period 1973:1 to 1975:1, a period which corresponds to the non-freeze portion of the controls and return to no controls. It was anticipated that the coefficients of the first two dummy variables would be negative while that of the third would be positive—the latter reflecting an increase in the inflation rate as firms and workers attempt to secure previously prevented wage and price increases. While as noted earlier the results are mixed (see footnote 3), all three dummy variables are retained in the inflation equation. Even though the program proxied by the guidepost variable may have had a negligible effect on inflation, it may have had a significant effect upon Federal Reserve policy.

III. The Federal Reserve Reaction Function

An essential element in the analysis of the relationship between fiscal policy and the money supply is the Federal Reserve reaction function. Theoretically, the monetary authority is viewed as acting as though it minimizes a static quadratic loss function subject to its perception of the structure of the economy, which is represented by equations 1–9 and 11–12, Table I. The loss function contains as arguments the weighted squared deviations of actual from desired values for real output, the inflation rate, the balance of trade, and the short-term interest rate. The first three arguments are measures of macroeconomic stabilization goals. The last argument is employed as a proxy for Federal Reserve concern for financial market stability.

Solution of the Federal Reserve's optimization problem leads to specification of a reaction function which relates unborrowed reserves to the lagged endogenous and exogenous variables of the model—which include the fiscal variables—and to the desired values of the arguments in the loss function. The reaction function is formally derived and the anticipated impacts of the fiscal variables upon unborrowed reserves are analyzed in the appendix to this paper.

The reaction function estimated in this paper differs somewhat from the theoretical function described above. A reaction function derived from the loss function and equations 1–9 and 11–12, Table I, would contain eighteen lagged endogenous and exogenous variables and four variables for the desired values of the arguments in the loss function. It was felt that including all of these variables in the estimation of the reaction function would be needlessly complex and would undesirably reduce the degrees of freedom. Hence, Y_{t-1} was employed as a proxy for all lagged endogenous and exogenous variables except G_t^F, $T_t^{F,EX}$, GP, WPC, and $WPCAF$.[12] The reaction function was thus estimated by regressing unborrowed reserves (adjusted for reserve requirement changes) on these six variables and desired values for real income, the inflation rate and the short-term interest rate. Since it was assumed that the de-

12. Since E_t is an exogenous variable it should be in the reaction function. However, it cannot be assumed that Y_{t-1} is a proxy for E_t. The reaction function was estimated with E_t as a separate explanatory variable. However, the t-statistic indicated the coefficient was not significantly different from zero, and a general linear test of the significance of this coefficient led to nonrejection of the null hypothesis that the coefficient was equal to zero.

sired balance of trade was neither surplus nor deficit, no term for this objective appears in the estimated reaction function. In addition, several dummy variables designed to capture any shifts in Federal Reserve behavior appear in the estimated reaction function.[13]

The reaction function estimated here indicates a good fit to the data ($\bar{R}^2 = .998$) and the coefficients are, with one exception, of the anticipated sign. The coefficient on Federal government expenditures (.022) is positive and the coefficient on exogenous federal tax receipts (−.029) is negative.[14] As shown in the appendix, these signs are expected when the weight on financial market stability exceeds the weighted sum of the other weights in the Federal Reserve loss function. Thus, within the same quarter, the Federal Reserve on balance accommodated expansionary or contractionary fiscal policy, thereby reinforcing the effect of fiscal policy variables upon other endogenous variables within the system.

The coefficient on Y_{t-1} is positive (.016). Since Y_{t-1} is employed as a proxy for the aggregate demand effects of the excluded lagged endogenous and exogenous variables, the anticipated sign on Y_{t-1} depends upon the relative weights in the loss function. Since the coefficient is positive, the Federal Reserve is seen as accommodating increases in aggregate demand from the sources proxied by Y_{t-1}.

Real high-employment GNP (RYH_t) is used as a measure of desired real income. As expected, the coefficient on RYH_t is positive (.005), thus indicating an expansion (contraction) in UBR_t as desired real income rises (falls).

To test the proposition that Federal Reserve response to desired real income differed with different political administrations, interaction dummy variables were employed in estimates of the reaction function. One interaction dummy variable, *IDRYH*, consisted of the actual values of RYH_t in the period of the Kennedy-Johnson administration, 1961:01—1968:04, and zeros in other periods. The other dummy variable, *IRRYH*, consisted of the actual values of RYH_t from 1969:01—1976:04, the period spanning the Nixon-Ford administration, and zeros in other periods. The estimated coefficient on *IDRYH* (−.0002) is not significantly different from zero. However, the estimated coefficient on *IRRYH* (−.0006) is statistically significant at the 5% level.

Specification of the desired inflation rate ($\dot{P}_t^D$) is especially difficult and several reasonable alternatives exist. The specification used in this study is based upon the assumption that the Federal Reserve desires to linearly reduce a moving average of past inflation rates to zero over the next 8 quarters. Thus, $\dot{P}_t^D = \dot{P}_t^{MA} - (\dot{P}_t^{MA}/8)$ where $\dot{P}_t^{MA} = (\dot{P}_{t-1} + \dot{P}_{t-2} + \dot{P}_{t-3} + P_{t-4})/4$. This specification is consistent with the assumption that the Federal Reserve does not want to induce large quarter-to-quarter fluctuations in the inflation rate, perhaps because of a concern that large fluctuations increase uncertainty and worsen the performance of the economy.[15] Furthermore, a reading of various policy directives and monetary policy reports indicates to us that when actual inflation rates have been high the Federal Reserve will have a higher desired inflation rate than when actual rates have been low. The measure employed here captures this phenomenon.

The coefficient on the desired inflation rate is negative (−.001), the opposite of the ex-

13. The use of dummy variables is a crude way of investigating the stability of the coefficients in the reaction function over time. The dummy variables in equation 10, Table I suggest that at least some of the coefficients may vary over time.

14. Using unadjusted data, the reaction function was also estimated using the new CEA estimates of high-employment expenditures and tax receipts; the coefficient on high-employment expenditures was .026 and the coefficient on high-employment receipts was −.015. Both were statistically significant.

15. For a discussion of the costs of increased variability in the inflation rate, see Fischer and Modigliani [7].

pected sign. However, this coefficient is not statistically significant in equation 10, which also contains interaction dummies for the desired inflation rate. (In a regression excluding the interaction dummies the coefficient is both positive and statistically significant.)

To test the proposition that Federal Reserve response to the desired inflation rate differed with different political administrations, two interaction dummies were used. The first, *IIDEMO*, consists of the actual values of $\dot{P}_t^D$ from 1961:01—1968:04 and zeros in other periods. The second, *IIREP2*, consists of the actual values of $\dot{P}_t^D$ from 1969:01—1976:04 and zeros in other periods. The estimated coefficients on both interaction dummies are positive and statistically significant at the 5% level. However, a t-test revealed no significant difference in the magnitude of these coefficients.[16]

The short-term interest rate in the previous quarter (i_{t-1}^m) is employed as a measure of the desired level of the short-term interest rate. Thus, financial market stability is defined as the absence of large quarter-to-quarter movements in the short-term interest rate.[17] The estimated coefficient on i_{t-1}^m is negative (–.576), thus conforming to theoretical expectation. That is, an increase (decrease) in the desired short-term rate induces a reduction (increase) in UBR_t.

To test the proposition that Federal Reserve response to the desired short term interest rate shifted with its announced increased emphasis on controlling the monetary aggregates in mid-1970, an interaction dummy variable was employed in the reaction function. The dummy variable, *IRTBL*, consists of actual values of the desired short-term interest rate from 1970:03—1976:04 and zeros in other periods. The estimated coefficient on IRTBL is positive (.059) and is statistically significant at the 5% level.

Finally, since government programs like guideposts and wage and price controls are designed to control the inflation rate, one might expect the Federal Reserve to be more expansionary during such periods than it would otherwise be, given the actual relation between aggregate demand and capacity. As expected, the estimated coefficients on *GP*, *WPC*, and *WPCAF* are all positive; *WPCAF* and *WPC* are significant at the 10% level, but *GP* is not statistically significant.[18]

IV. Estimated Fiscal Policy Effects on the Money Supply

The immediate response of the money supply to the fiscal policy variables is estimated by solving the simultaneous system of equations for the reduced form money supply equation.[19]

16. The Board of Governors of the Federal Reserve was chaired by two different individuals in the time period covered by this study. To test whether a change in chairmanship had an effect on Federal Reserve policy, a dummy variable consisting of 0's during Chairman Martin's term and 1's during Chairman Burn's term was added to the reaction function. However, the coefficient on this variable was not statistically significant and it was dropped from the equation.

17. Studies which have used i_{t-1}^m as the desired rate of interest include P. Derosa and G. Stern [4] and R. T. Froyen [10].

18. Alternative specifications of the desired inflation rate can change reaction function estimates in various ways, although in no case did any of the alternative measures of $\dot{P}^D$ that we tried have a significant effect on the parameter estimates in other equations. For example, one alternative specification that insures that the desired inflation rate in t is always below the actual rate in $t-1$ defines $\dot{P}^D = (\dot{P}_{t-1} - 1\%)$ for $(\dot{P}_{t-1} - 1\%) > 0$; $= 0$ for $(\dot{P}_{t-1} - 1\%) < 0$. In this case, *WPC* is significant at the 5% level, while *IRRYH* and *WPCAF* are no longer significant. The estimated coefficients on $\dot{P}^D$ and the interaction dummy variables *IIDEMO* and *IIREP2* are (t-statistics in parentheses): −.026 (−.59); .123 (1.68), and .079 (1.39), respectively. The coefficients on G_t^F and $T_t^{F,EX}$ in this estimation are .028 (3.41) and −.055 (−5.00), respectively.

19. The reduced form money supply equations for Cases I and II are not presented here in order to conserve space. Copies of these equations are available upon request from the authors.

For Case I, Federal Reserve behavior exogenous, the reaction function is excluded from the model and *UBR* are thus treated as exogenous. For Case II, Federal Reserve behavior endogenous, the reaction function is retained in the model. It should be noted that the coefficients on the explanatory variables are estimates of the immediate effects—the *impact* multipliers—of the variables.

For Case I, an increase in government purchases of $1 billion leads to an increase in the money supply of $.054 billion in the same quarter; an exogenous tax cut of $1 billion leads to an increase in the money supply of $.011 billion in the same quarter. For Case II, the comparable increases in the money supply are $.173 billion and $.165 billion, respectively.[20]

A comparison of Cases I and II thus reveals a substantial difference in the size of fiscal multipliers. The inclusion of a Federal Reserve reaction function is responsible for the considerably larger multipliers. In Case II, the change in the money supply is a result of changes in UBR_t due to Federal Reserve response to the state of fiscal policy and private sector response both to the state of fiscal policy and to the induced changes in the monetary policy variable.

V. Conclusions

Analysis of the impact of fiscal policy on the money supply requires consideration of the Federal Reserve's reaction to fiscal policy. Ignoring the Federal Reserve's response results in underestimating the effect of fiscal policy on the money supply within the same quarter.

Our empirical results support the contention that unborrowed reserves (and thus the money supply) are endogenous. Treatment of unborrowed reserves (and the money supply) as exogenous thus results in misspecification of the model. Our empirical results provide supporting evidence for the Goldfeld-Blinder [12] argument that model multipliers will be biased if policymakers react systematically to the state of the economy over the period of estimation and this systematic reaction is not explicitly accounted for in the model. Furthermore, the results support the notion that changes in Presidential administrations affect Federal Reserve behavior, a finding similar to that of other researchers in this area.[21] Finally, the results provide tentative support for the assertion that Federal Reserve concern for financial market stability has shifted since mid-1970 when the Federal Reserve began to place more emphasis upon the monetary aggregates.[22]

But what of the contention by some economists that fiscal expansion results in (presumably) substantial increases in the monetary aggregates and the money supply? Here, our evidence must be evaluated carefully. First, one could quibble over whether or not the size of our impact multipliers indicates a "substantial" fiscal impact on the money supply. Of greater interest might be the derivation of dynamic multipliers for the fiscal variables (which is a subject for future research). Second, Federal Reserve behavior is significantly influenced by goals other than financial market stability. The estimated coefficients on the fiscal variables in the reaction function indicate that, *on balance*, the Federal Reserve weights financial

20. For Case II, with the estimation employing the alternative measure of desired inflation defined in footnote 18, the respective increases in the money supply are $.205 billion and $.301 billion.

21. See, for example, Potts and Luckett [24], Friedlaender [9], Froyen [10], and Havrilesky, Sapp, and Schweitzer [16].

22. This conclusion is similar to one drawn by DeRosa and Stern [4].

market stability more heavily than the macro stabilization goals within the same quarter. That is, while the Federal Reserve does exhibit counter-cyclical policy concerns, these concerns are dominated by a concern for financial market stability.

Appendix

The Federal Reserve is viewed as acting as though it minimizes a quadratic loss function $l = (A_t - A_t^*)' W(A_t - A_t^*)$ subject to the reduced form (which is derived assuming certainty equivalence from the structural model, excluding equation 10, listed in Table I)

$$A_t = JR_t + HZ_t \text{ where}$$

$$A_t = \underset{4 \times 1}{\begin{bmatrix} y_t \\ \dot{P}_t \\ BT_t \\ i_t^m \end{bmatrix}}$$

and y_t = real output, $\dot{P}_t$ = inflation rate, BT_t = balance of trade, and i_t^m = short-term interest rate,

$$A_t^* = \underset{4 \times 1}{\begin{bmatrix} y_t^* \\ \dot{P}_t^* \\ BT_t^* \\ i_t^{m*} \end{bmatrix}}$$

and the * indicates desired values for the elements of A_t,

$$W = \underset{4 \times 4}{\begin{bmatrix} w_1 & 0 & 0 & 0 \\ 0 & w_2 & 0 & 0 \\ 0 & 0 & w_3 & 0 \\ 0 & 0 & 0 & w_4 \end{bmatrix}}$$

and w_t = weights on the deviations $(A_t - A_t^*)$; $w_i > 0$ for $i = 1, \cdots, 4$,

$$J = \underset{4 \times 1}{\begin{bmatrix} j_1 \\ j_2 \\ j_3 \\ j_4 \end{bmatrix}}$$

and j_i, $i = 1, \cdots, 4$ = reduced form coefficients on the monetary policy variable; $j_1, j_2 > 0$; $j_3, j_4 < 0$,

$$R = \underset{1 \times 1}{[\check{U}BR_t]}$$

and UBR_t (unborrowed reserves adjusted for reserve requirement changes) = monetary policy variable,

$$H = \underset{4 \times 14}{\begin{bmatrix} h_{11} & h_{12} & h_{13} & \cdots & h_{114} \\ h_{21} & h_{22} & h_{23} & \cdots & h_{214} \\ h_{31} & h_{32} & h_{33} & \cdots & h_{314} \\ h_{41} & h_{42} & h_{43} & \cdots & h_{414} \end{bmatrix}}$$

and h_{ij}, $i = 1, \cdots, 4; j = 1, \cdots, 14$, = reduced form coefficients on the exogenous and lagged endogenous variables in the structural model, and

$$\underset{14 \times 1}{Z_t = \begin{bmatrix} X_t^1 \\ \hline X_t^2 \end{bmatrix}} \quad \text{where } \underset{3 \times 1}{X_t^1 = \begin{bmatrix} 1 \\ G_t^F \\ T_t^{F,EX} \end{bmatrix}}$$

and G_t^F = federal expenditures, $T_t^{F,EX}$ = exogenous federal net tax receipts, and $X_t^2 = 11 \times 1$ vector of other lagged endogenous and exogenous variables in the system. For a discussion of the structural model that lies behind the reduced form and the anticipated signs of h_{ij}, see McMillin [19].

The solution to the Federal Reserve's constrained minimization problem is $R_t = [J'WJ]^{-1}J'WA_t^* - [J'WJ]^{-1}J'WHZ_t$ which can be interpreted as the Federal Reserve reaction function. The expected signs on the coefficients for A^* and Z_t can be determined by analyzing $[J'WJ]^{-1}J'W$ and $[J'WJ]^{-1}J'WH$.

$[J'WJ]^{-1}$ is the scalar $1/(w_1j_1^2 + w_2j_2^2 + w_3j_3^2 + w_4j_4^2)$ and is positive since w_i and j_i^2, $i = 1, \cdots, 4$ are positive. For notational convenience, let $[J'WJ]^{-1} = 1/D$.

$[J'WJ]^{-1}J'W$ is a 1×4 vector of coefficients on the desired values of the elements of A_t. This vector is $(1/D)[w_1j_1w_2j_2w_3j_3w_4j_4]$. The first element is the coefficient on y_t^* and since $w_1, j_1 > 0$ the expected sign is > 0. The second element is the coefficient on $\dot{P}_t^*$ and since $w_2, j_2 > 0$ the expected sign is > 0. The third element is the coefficient on BT^* and since $w_3 > 0$ and $j_3 < 0$ the expected sign on this coefficient is < 0. The final element is the coefficient on i_t^{m*} and since $w_4 > 0$ and $j_4 < 0$ the expected sign on this coefficient is < 0. It should be noted that the absence of countercyclical policy concerns implies w_1, w_2, and $w_3 = 0$. In this case, the expected signs on y_t^*, $\dot{P}_t^*$, and $BT^* = 0$.

$[J'WJ]^{-1}J'WH$ is a 1×14 vector of coefficients on Z_t. Since the primary concern of this paper is with the effects of fiscal policy upon the money supply, only the expected signs of the coefficients on G_t^F and $T_t^{F,EX}$ will be analyzed. The coefficient on G_t^F is $(1/D)[-w_1j_1h_{12} - w_2j_2h_{22} - w_3j_3h_{32} - w_4j_4h_{42}]$ and the coefficient on $T_t^{F,EX}$ is $(1/D)[-w_1j_1h_{13} - w_2j_2h_{23} - w_3j_3h_{33} - w_4j_4h_{43}]$. The following assumptions about the h_{ij} are made: $h_{12}, h_{22}, h_{42} > 0$ and $h_{32} < 0$ and $h_{13}, h_{23}, h_{43} < 0$ and $h_{33} > 0$.

Thus, the coefficient on G_t^F will be $\gtreqless 0$ if $w_4 \gtreqless [w_1(j_1h_{12}/j_4h_{42}) + w_2(j_2h_{22}/j_4h_{42}) + w_3(j_3h_{32}/j_4h_{42})]$. Since w_4 is the weight on the financial market stability proxy, if this weight exceeds a weighted average of the other weights then the Federal Reserve will accommodate expansionary fiscal policy. The coefficient on $T_t^{F,EX}$ will be < 0 (indicating an accommodative response) if $w_4 > [w_1(j_1h_{13}/j_4h_{43}) + (w_2(j_2h_{23}/j_4h_{43}) + w_3(j_3h_{33}/j_4/h_{43})]$.

Thus in empirical estimates of the reaction function, a positive coefficient on G_t^F (or any other expansionary nominal demand shock) and a negative coefficient on $T_t^{F,EX}$ coupled with the anticipated signs on y^*, $\dot{P}^*$, and BT^* do not imply the absence of countercyclical monetary policy concerns, but only that within the same quarter financial market stability is *relatively* more important than countercyclical concerns. A positive coefficient on G_t^F (or any other expansionary nominal demand shock), a negative coefficient on $T_t^{F,EX}$, and coefficients not significantly different from zero on y^*, $\dot{P}^*$, and BT^* would suggest the absence of counter-cyclical monetary policy concerns.

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