A Dynamic Analysis of the Impact of Fiscal Policy on the Money Supply

*A Note by W. Douglas McMillin**

1. Introduction

Although a positive (accommodative) fiscal policy-money supply relationship is frequently suggested [3, 5], often because of an hypothesized overriding concern by the Federal Reserve with stabilizing interest rates, the available empirical evidence is mixed.[1] With the exception of [4], the empirical studies have provided estimates of the impact multipliers for various fiscal variables on alternative monetary variables, but they have not addressed the question of the impact of a sustained change in a fiscal variable upon the money supply over time. In a world in which fiscal variables affect financial and product sector variables with a lag, the examination of only the impact multipliers may give an incomplete and/or misleading picture. Thus, the aim of this paper is to extend the analysis to a dynamic setting in which the impact of the fiscal variables upon the time path of M1 is examined within the context of a small macroeconomic model. In particular, dynamic multipliers for the money supply are derived and analyzed.

2. Discussion of the Federal Reserve Reaction Function

The structural model employed is similar to that used in an earlier paper by McMillin and Beard [10]. It is a linear variant of the *IS-LM* model that incorporates endogenous taxes, an endogenous wealth variable, and inflationary expectations. The model is estimated by iterative three-stage least squares from nominal seasonally adjusted quarterly data beginning in 1953.I and ending in 1976.IV. Since the model is of a standard nature, the estimates of the structural model will not be presented here, but are available from the author upon request.

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[1]Some evidence of a positive relationship is found in [1, 2, 7, 10, 11]. Some evidence of a nonaccommodating relationship is found in [4, 6, 9, 12]. It should be noted, however, that with the exception of [2, 4, 10,11], the chief aim of these studies was not the investigation of the fiscal policy-money supply relationship. In many cases, the evidence is weak and/or the conclusions ambiguous.

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An essential element of the analysis is the treatment of Federal Reserve behavior as endogenous. The Federal Reserve is viewed as acting as though it minimizes a quadratic loss function subject to its perception of the structure of the economy. The loss function is given by

$$l = w_1(y_t - y_t^*)^2 + w_2(\dot{P}_t - \dot{P}_t^*)^2 + w_3(BT_t - BT_t^*)^2 + w_4(i_{m,t} - i_{m,t}^*)^2. \quad (1)$$

It thus contains as arguments the weighted squared deviations of actual from desired (indicated by the *) values for real output (y_t), the inflation rate ($\dot{P}_t$), the balance of trade (BT_t), and the short-term interest rate ($i_{m,t}$). The first three arguments are measures of macroeconomic stabilization goals, and the last argument is a proxy for Federal Reserve concern for financial market stability.

Minimization of l subject to the structural model leads to specification of a reaction function that relates the Federal Reserve's policy variable—assumed to be unborrowed reserves adjusted for reserve requirement changes (UBR)—to the lagged endogenous and exogenous variables of the structural model (which include fiscal policy variables) and to the desired values of the arguments in the loss function.[2] The coefficients of this function are complex mixtures of the loss-function weights and the structural parameters. This reaction function contains twenty-two explanatory variables. However, to avoid undesirably reducing the degrees of freedom for the estimation, nominal output lagged one period (Y_{t-1}) is employed as a proxy for all lagged endogenous and exogenous variables other than exogenous Federal purchases of goods and services (G_t^F) and exogenous Federal net tax receipts ($T_t^{F,EX}$). The estimated reaction function is (t-statistics are in parentheses)[3]

$$\begin{aligned} UBR = {} & \underset{(6.21)}{2.57} + \underset{(4.02)}{0.026}G_t^F - \underset{(-2.38)}{0.027}T_t^{F,EX} + \underset{(19.73)}{0.015}Y_{t-1} + \underset{(6.88)}{0.007}y_t^* \\ & + \underset{(3.27)}{0.133}\dot{P}_t^* - \underset{(-13.31)}{0.583}i_{m,t}^* + \underset{(2.51)}{0.075}IRTBL, \end{aligned} \quad (2)$$

$$\bar{R}^2 = 0.998, \text{ SEE} = 0.124.$$

All explanatory variables are statistically significant at the 5 percent level.

The estimated coefficients on the fiscal variables, G_t^F (0.026) and $T_t^{F,EX}$ (−0.027), indicate that the Federal Reserve accommodates expansionary fiscal policies within the same quarter. Within the theoretical framework of this paper, these coefficient signs are expected when the Federal Reserve weights financial market stability more heavily than its macrostabilization goals.[4]

[2]The reaction function is formally derived in the appendix to [10].

[3]It was assumed that BT_t^* was neither surplus nor deficit, so BT_t^* does not appear in the estimated reaction function.

[4]From [10], 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 $(1/D)[-w_1j_1h_{13} - w_2j_2h_{23} - w_3j_3h_{33} - w_4j_4h_{43}]$, where $D = (w_1j_1^2 + w_2j_2^2 + w_3j_3^2 + w_4j_4^2)$ and

The coefficient on y_t^* (measured by high-employment real GNP) is positive. A positive coefficient on y_t^* suggests the existence of counter-cyclical policy concerns since it implies that the weight on $(y_t - y_t^*)^2$ in the loss function is greater than zero.[5]

Based upon the assumption that the Federal Reserve does not want to induce large quarter-to-quarter fluctuations in the inflation rate, $\dot{P}_t^*$ is defined as a four-quarter moving average of actual inflation rates. As expected, the coefficient on $\dot{P}_t^*$ is positive and provides further evidence of the existence of counter-cyclical policy concerns.[6]

The desired short-term interest rate, $i_{m,t}^*$, is defined as $i_{m,t-1}$. This measure is consistent with defining financial market stability as the absence of large quarter-to-quarter movements in the short-term interest rate. The estimated coefficient on $i_{m,t}^*$ is negative (−0.583), as expected.[7] An interaction dummy variable, *IRTBL*, is added to test the proposition that Federal Reserve response to $i_{m,t}^*$ shifted with its announced increased emphasis upon controlling monetary aggregates in mid-1970. *IRTBL* consists of $i_{m,t}^*$ from 1970.III to 1976.IV and zeros elsewhere. The estimated coefficient on *IRTBL* is positive.

In summary, the estimated coefficients on G_t^F and $T_t^{F,EX}$ are anticipated when the Federal Reserve weights financial market stability more heavily than its macroeconomic stabilization goals. At the same time, the estimated coefficients on y_t^* and $\dot{P}_t^*$ are consistent with Federal Reserve counter-cyclical policy concerns. This conclusion is reinforced by the positive coefficient on Y_{t-1}.[8]

3. *Predictive Properties of the Model*

Although the $\bar{R}^2$s indicate good fits to the data for the individual equations, the predictive ability of the model is not adequately evaluated by examining the $\bar{R}^2$s. Several additional tests of the predictive ability of the model are performed. An historical sixty-four-quarter dynamic simulation of the model was run for the period

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$w_i, i = 1 \ldots, 4$ = loss function weights in text equation (1). $j_i, h_{i2}, h_{i3}, i = 1, \ldots, 4$ are the coefficients on UBR_t, G_t^F, $T_t^{F,EX}$ in the reduced-form equations (from the structural model) for y_t, P_t, BT_t, and $i_{m,t}$, respectively. For example, j_1, h_{12}, h_{13} are the coefficients on UBR_t, G_t^F, and $T_t^{F,EX}$ in the equation for y_t. Standard theory leads to the expectation that $j_1, j_2, h_{12}, h_{22}, h_{42}, h_{33} > 0$ and $j_3, j_4, h_{32}, h_{13}, h_{23}, h_{43} < 0$. Thus if w_4 (the weight on the financial-market stability proxy) exceeds the weighted sum of the stabilization goal weights, the expected signs on G_t^F and $T_t^{F,EX}$ are positive and negative, respectively. For example, if $w_4 > [w_1(j_1h_{12}/j_4h_{42}) + w_2(j_2h_{22}/j_4h_{42}) + w_3(j_3h_{32}/j_4h_{42})]$, the expected sign of G_t^F is positive.

[5]From [10], the coefficient on y_t^* is $(1/D)[w_1j_1]$. As noted in note 4, D and $j_1 > 0$. Thus the coefficient is expected to be > 0 if $w_1 > 0$.

[6]Alternative measures of $\dot{P}_t^*$ are discussed in [10]. From [10], the coefficient on $\dot{P}_t^*$ is $(1/D)[w_2j_2]$. As noted in note 4, D and $j_2 > 0$. Thus, if $w_2 > 0$, the coefficient is expected to be > 0.

[7]From [10], the coefficient on $i_{m,t}^*$ is $(1/D)[w_4j_4]$. Since $D > 0$ and $j_4 < 0$ (note 4), if $w_4 > 0$, then the coefficient is expected to be < 0.

[8]To test whether Federal Reserve response to y^* and P^* varied with changes in presidential administrations, several interaction dummy variables were added to the reaction function. The use of interaction dummy variables is a crude way of testing for structural shifts. It was felt that this was preferable to splitting the sample into three subsets of thirty-two observations and estimating the *entire* system with only thirty-two observations. The estimated coefficients on these variables provide some evidence of shifts in Federal Reserve behavior, although not all are significant at the 5 percent level. However, there are no statistically significant changes in the estimated coefficients on G^F and $T^{F,EX}$ or any basic changes in the dynamic multipliers when these variables are added; therefore, the simpler formulation is used in the text. The coefficient and dynamic multiplier estimates are available upon request from the author.

1961.I to 1976.IV. The simulation is dynamic in the sense that the values of the lagged endogenous variables in quarters subsequent to 1961.I are their predicted values, not their historical values. Actual values of exogenous variables are employed in the simulation, and no adjustments are made to any of the behavioral equations in the model. The results of this simulation are compared with the results from an historical dynamic simulation of a naive forecasting model[9] and with the results from an out-of-sample dynamic simulation of the structural model for the period 1977.I to 1978.IV.

The Theil U statistic for the historical simulation of the structural model is 0.04. The percent root mean square errors (percent RMSEs) for M1 from the historical simulations of the structural and autoregressive models are 0.60 percent and 3.33 percent, respectively. The percent RMSE for the out-of-sample simulation is 1.48 percent. The simple correlation coefficient for the actual and predicted values for the historical simulation for M1 is 0.989, and 92 percent of all turning points in M1 are correctly predicted. Based upon these results, the model's ability to track M1 is quite good.

4. *Dynamic Multipliers for M1*

The impact of fiscal policy upon the time path of the money supply can be evaluated by computing dynamic multipliers for M1 for changes in the exogenous fiscal policy variables. The dynamic multipliers are calculated from the differences in the time paths of M1 from the historical dynamic simulation and dynamic simulations from 1961.I to 1976.IV for a sustained \$1 billion increase in G^F, a sustained \$1 billion decrease in $T^{F,EX}$, and a sustained \$1 billion increase in the federal deficit. For purposes of comparison, dynamic multipliers for exogenous Federal Reserve behavior were calculated from simulations of the model with the reaction function suppressed. All changes in the fiscal variables are from their historical values.

Both dynamic multipliers and cumulative dynamic multipliers (which give the total change in M1 in response to a change in a fiscal variable over both the current and all previous periods) are shown in Table 1. From Table 1, we see that the dynamic multipliers decline over time, though there is some oscillation in their movements. After four years, the cumulative change in G^F($T^{F,EX}$)(Federal deficit) is \$4 billion (−\$4 billion)(\$4 billion), and the cumulative change in M1** (endogenous Federal Reserve) is \$0.687 billion (\$0.603 billion)(\$0.703 billion). The elasticities of M1** at the end of four years with respect to the fiscal variables are not very large; for example, the elasticity of M1** with respect to G^F evaluated at the simulation period means is 0.074. Both sets of multipliers vary considerably depending upon the assumption about Federal Reserve behavior. The multipliers for M1* (exogenous Federal Reserve) reflect only private sector response to fiscal

[9]The equation used is (t-statistics are in parentheses)

$$\underset{}{M1_t} = \underset{(-2.5)}{-1.3} + \underset{(13.96)}{1.5M1_{t-1}} - \underset{(-3.40)}{0.67M1_{t-2}} + \underset{(1.60)}{0.32M1_{t-3}} - \underset{(-1.20)}{0.14\,M1_{t-4}}.$$

changes and are much smaller than the multipliers for M1**, which reflect both private sector and Federal Reserve response to fiscal changes.

TABLE 1

DYNAMIC MULTIPLIERS FOR M1

	$1 Billion Increase in G^F		$1 Billion Decrease in $T^{F,k,\backslash}$		$1 Billion Increase in Federal Deficit
Period	M1*	M1**	M1*	M1**	M1**
0	0.055	0.192	0.012	0.153	0.213
1	0.014	0.115	0.012	0.078	0.110
2	0.012	0.065	0.012	0.049	0.062
3	0.013	0.044	0.012	0.037	0.043
	(0.094)	(0.416)	(0.048)	(0.317)	(0.428)
4	0.012	0.036	0.012	0.035	0.038
5	0.012	0.030	0.012	0.030	0.031
6	0.012	0.029	0.012	0.029	0.029
7	0.010	0.027	0.011	0.028	0.028
	(0.140)	(0.538)	(0.095)	(0.439)	(0.554)
8	0.007	0.028	0.009	0.030	0.029
9	0.008	0.026	0.009	0.027	0.027
10	0.008	0.025	0.009	0.027	0.025
11	0.008	0.027	0.009	0.028	0.028
	(0.171)	(0.644)	(0.131)	(0.551)	(0.663)
15	0.004	−0.028	0.006	−0.025	−0.028
	(0.200)	(0.687)	(0.166)	(0.603)	(0.703)

NOTE: Cumulative dynamic multipliers are in parentheses.
*Federal Reserve behavior exogenous (UBR exogenous).
**Federal Reserve behavior endogenous (UBR endogenous)

5. *Summary and Conclusions*

The purpose of this paper is to estimate the impact of changes in several fiscal policy variables upon the time path of the narrowly defined money supply. The magnitude of the dynamic multipliers varies substantially according to the assumption about Federal Reserve behavior. The considerably smaller multipliers for exogenous Federal Reserve behavior suggest that failure to model Federal Reserve response to fiscal policy will lead to underestimates of the effect of fiscal actions on the money supply and also provide empirical support for the Goldfeld and Blinder [8] argument that model multipliers will be biased if policymakers react systematically to the state of the economy and this systematic reaction is not explicitly accounted for in the model.

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