Impact of Monetary and Fiscal Policies on Real Output

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INTRODUCTION

A major implication of the Macro Rational Expectations (MRE) literature is the importance of distinguishing between anticipated and unanticipated components of policy actions when analyzing the effects of those policy actions on real variables like real output or unemployment. According to Lucas [9, 10] and Sargent and Wallace [17], the theoretical implication of the MRE hypothesis is that only unanticipated policy actions can affect real variables in the short-run. The pioneer empirical studies by Barro [1, 2] appeared to support this hypothesis. However, recent studies by Mishkin [14, 15], Maki [13], Gooden [6], among others, have cast doubt on earlier finding of Barro. These studies dealt only with the impact of monetary policy on real output and employment.

The effects which measures of anticipated and unanticipated fiscal policy have on real output has been investigated by Laumas and McMullen [8] and by McMahon [12]. For the period 1960:3 to 1982:4, Laumas and McMullen showed that not only the unanticipated fiscal actions, but also the anticipated fiscal actions affect real output. This is contrary to the rational expectations-灵活 wage and price model of the type suggested by Meilanim and Whittaker [11]. Laumas-McMullen results did not provide any direct evidence on the appropriateness of the assumption of rational expectations formation, for their results are consistent with the rational expectations models with sticky wages and prices of the Fisher [4] type. Their results also cast doubt on the appropriateness of models that impose rationality and short-run neutrality.

The aim of this paper is to test the impact of both monetary and fiscal variables in the determination of real output. Since both policies may be employed in response to exogenous shocks to real output, ignoring the impact of one policy may produce biased results. Thus previous studies which included only the monetary variables or studies which included only the fiscal variables may suffer from omitted variable problem which may have provided biased and inconsistent coefficient estimates of the impact of policy actions on real output. Of course, real output is affected by a number of variables other than monetary and fiscal actions, and the omitted variables problem is not completely solved.

Briefly, the results of this paper show that both anticipated and unanticipated fiscal policy and anticipated monetary policy significantly affected real output; unanticipated monetary growth did not have a lasting impact on real output; and there is an insignificant relationship among monetary and fiscal variables.

Section 2 of this paper is devoted to estimating the anticipated policy equations. Section 3 presents the empirical results of estimating the impact of policy actions on real output. A brief summary and conclusions are given in section 4.

SPECIFICATION OF THE ANTICIPATED POLICY EQUATIONS

The real output variable is measured by the growth rate of real GNP, (RY). The monetary variable used is the growth rate of M2 and the fiscal variable examined is the change in the real cyclically-

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adjusted budget surplus scaled by the real middle-expansion trend GNP. This scaling of the fiscal variable assures that it is not contaminated with changes in expenditures or tax receipts due to the automatic stabilizing aspects of fiscal policy.\footnote{The technique employed here to specify the anticipated policy equations involves the use of the Granger-causality definition in conjunction with Thiel's RM (minimum standard error) criterion to specify the appropriate lag length for each variable considered. Since a similar technique is employed in the specification of both monetary and fiscal equations, to save space, the description of the technique will focus upon the monetary policy equation. The macroeconomic variables considered for inclusion in this equation are: the unemployment rate, the inflation rate, measures of inflation uncertainty, trade-weighted rate of the dollar, balance-of-payments on current account, the rate of growth of real GNP, the growth rate of publicly held federal debt, the rate of growth in nominal GNP, the fiscal policy variable, real net exports, the rate of change in the import price deflator, the three-month Treasury bill rate, and Standard and Poor's 500 common stock price index. These variables are chosen because of their macroeconomic interest and because information about these variables is easily obtained at low cost and thereby might be used by the public to predict the stance of monetary policy. As is well-known, one variable (X) is said to Granger-cause another (Y) if the past values of Y in conjunction with the past values of X can be used to predict Y more accurately than just past values of Y. Thus, the first step in the specification of the anticipated monetary policy equation is the determination of the own lag length for the monetary variable. This determination is made by varying the lag in the autoregression

\[ M_t = a_0 + a_1 M_{t-1} + \epsilon_t \]

A lag-m operator so that \( L^m M_t = M_{t-1} \), \( L^m \) is the highest order lag predicted a priori to be 10, and \( \epsilon_t \) is zero mean white noise error term. The lag length that yields the highest R-squared is selected as the order of \( a_1 (L) \).

Once the order of \( a_1 (L) \) is found, a determination of whether other macro variables enter the anticipated monetary policy equation is made. The procedure begins with the estimation of the bivariate equation

\[ M_t = a_0 + a_1 (L) M_{t-1} + a_2 (L) X_t + \epsilon_t \]

where \( X_t \) are relevant macro variables (considered one at a time) and \( a_2 (L) \) is a distributed lag polynomial defined in a manner similar to \( a_1 (L) \). The lag length that yields the highest R-squared is selected as the lag order for the macro variable. An F test of the joint significance of the coefficients on the macro variable is then performed. If the coefficients are significantly different from zero, the variable is said to Granger-cause M and this variable is retained for further consideration. If the coefficients are not significantly different from zero, the variable is said not to Granger-cause M and is not considered further.

The macro variables further considered for inclusion in the monetary policy equation are those found to Granger-cause M. The order in which these variables are considered is determined by the R-squared from the bivariate equations. The variables are ranked according to the R-squared from the relevant bivariate equations with the variable with the highest R-squared first, and so on. The trivariate equation

\[ M_t = a_0 + a_1 (L) M_{t-1} + a_2 (L) X_{t-1} + a_3 (L) Y_t + \epsilon_t \]

is estimated where \( X_{t-1} \), the variable with the highest R-squared in the bivariate equations, \( X_{t-1} \) is remaining macro variables (considered one at a time), and \( a_3 (L) \) is defined analogously to \( a_1 (L) \) and \( a_2 (L) \), \( a_3 (L) \) are fixed at their previously determined order and the lags in \( a_3 (L) \) are varied over \( p = 1, \ldots, m \). As before, the lag length that yields the highest R-squared is selected as the lag order for that macro variable.

As F test of the joint significance of the coefficients on the macro variable is then performed. Again, if the coefficients are significantly different from zero, the variable is said to Granger-cause M and is retained for further consideration. If the coefficients are not significantly different from zero, the variable is not considered further.

After the trivariate equations for all remaining macro variables are estimated, the variables found to Granger-cause M are again ranked according to R-squared, and the process continues in an analogous fashion until all variables are discarded or added to the monetary policy equation. The same process is applied to the fiscal policy variable. Use of this procedure and data from 1955:1 to 1982:2 led to the following specifications for the monetary and fiscal policy equations:

1. \[ F_t = b_0 + b_1 (L) F_t + b_2 (L) Y_t + b_3 (L) M_t + \epsilon_t \]

where the lag polynomial indicates the order of the lag; the optimal lag on M (defined as M2) is six quarters. \( F_t \) is the change in the real cyclical-adjusted budget surplus scaled by real middle-expansion trend GNP. The explanatory variables are defined as RB3 = three-month Treasury Bill rate, NY = rate of change in nominal GNP, DX = trade-weighted exchange rate of the dollar, U = unemployment rate for all workers, and IMP is the rate of change in the import price deflator. About 76% of the variation in money growth is explained\footnote{By equation (1) while about 46% of the variation in the fiscal variable is explained by equation (2). Following Mishkin [14], we note that the observational equivalence problem described by Sargent [16] is overcome since the anticipated policy equations contain lagged values of variables not directly included in the real output growth equation. Because of this it is possible to identify enough of the parameters of the real output growth equation to determine the differential effects of anticipated policy actions on real output. The temporal stability of these equations was checked by means of the Chow test. The sample was split into two parts at various points and the Chow test indicated that the hypothesis of stability of the coefficient could not be rejected at the 5% level.\footnote{These estimates indicated the absence of serial correlation in equations (1) and (2).}}

2. \[ M_t = a_0 + a_1 (L) M_{t-1} + a_2 (L) RTB_t + a_3 (L) NY_t + a_4 (L) DX_t + \epsilon_t \]

and the budget surplus is predictable with the following exceptions: M1 growth, RB3, NY, DX. The estimated tightness of the budget surplus and M1 growth has increased over the sample period.

\textbf{EMPIRICAL ESTIMATES}

The two-step procedure outlined in Barro [1] and Makin [13] is used to estimate the effects of anticipated and unanticipated policy actions on growth rate of real output (RY). In the first step of this procedure the policy equations (equations (1) and (2)) are estimated and the predicted values of these equations are used as the anticipated policy measures while the residuals are used as unanticipated policy actions. The second step consists of estimating the following equation:

\[ RY_t = d_0 + \sum d_1 A_i F_{t-i} + \sum d_2 A_i Y_{t-i} + \sum d_3 A_i M_{t-i} + \sum d_4 A_i X_{t-i} + \epsilon_t \]

where \( RY_t \) is the rate of growth in real output (measured as log real GNP in t-lag log real GNP in t-1), \( F_t \) is anticipated fiscal actions (i.e., the anticipated change in the real cyclically-adjusted surplus scaled by real middle-expansion trend GNP), \( Y_t \) is unanticipated fiscal actions, \( M_t \) is anticipated money growth, \( X_t \) is unanticipated money growth. Equation (3) was estimated using ordinary least squares and varying the lags of the right-hand-side variables from 4 to 15. Estimated equations with different lag lengths were tested for stability over time by means of the Chow test. The tests indicated that the hypothesis of stability could not be rejected at the 5% level.

Table 1 presents the estimates of equation (3) for the sample period: 1960:3 to 1982:2. Equation (3) was estimated using ordinary least squares and polynomial distributed lags. Based upon Mishkin's [14, 15] demonstration that specification of the lag length in equations like equation (3) importantly affects conclusions about the impact of anticipated policy actions on output, an explicit statistical criterion—
That’s $R^2$ (minimum standard error) criterion was used to determine the degree of polynomial length of lag and appropriateness of end-point constraints. Equations using alternative combinations of polynomial degree, lag length and type of end-point constraints were estimated; the combination of polynomial degree, lag length and type of end-point constraints that maximized the $R^2$ was selected as the appropriate specification of equation (3). As in the case of policy equations, the data are allowed to determine the appropriate specification of the RV equation. The criterion is also supported by Schmidt and Waud [18]. The use of the criterion suggested that the lag length of 16-quarters—current value and 15 lags of the policy variables—and a fourth degree polynomial with no end-point constraints was optimal. Before proceeding further, a brief comment is made on the correlation among policy variables. The absence of any significant correlation among policy variables provides support to the proposition that estimates of equation (3) which exclude one policy variables (monetary or fiscal) are not misspecified. Thus studies by Barro, Mithuk, Gordon, Makin (who estimate the impact of monetary variables only on real output) do not suffer from misspecification problems. As Batten and Hafer [3] point out, the statistical problem of bias due to misspecification is present only if the policy variables omitted are correlated with the included policy variables. The simple correlation among the four policy variables used in this study is not significantly different from zero. This provides confidence that statistical inferences drawn from estimating the joint impact of monetary and fiscal variables on real output would yield coefficient estimates which are unbiased and consistent.

A brief discussion of the estimates in Tables 1 is given below. In interpreting the coefficient of the fiscal variables, it should be pointed out that the fiscal measure employed here (with the exception of two observations) was in deficit during the total sample period analyzed in this study. Since the numerator of the fiscal variables is the change in the real cyclically-adjusted surplus, the negative coefficients indicate that an increase in the deficit raises real output. It should be further pointed out that one shot increase in the budget deficit would have only a transitory impact on real output growth. Since trend GNP grows over time, a sustained increase in budget deficit is required for the fiscal variable to have lasting impact on growth of real output.

Table 1, the sum of the coefficients of both AF and UF is negative and statistically significant, indicating that both anticipated and unanticipated fiscal variable had a positive impact on real output. Note that the absolute value of most of the coefficients of AF is greater than those of UF. However, the pattern of the impact of AF is similar to that of UF. The coefficients of current lag of AF and UF are not statistically significant at the 5 percent level. For AF, lags 1 through 10 have negative coefficients and are statistically significant. Lags 11 and 12 are negative and are not significant. Lags 13 and 15 have insignificant positive signs. This indicates that after the 10th lag, the impact of anticipated fiscal policy peter out. In the case of unanticipated fiscal policy, the coefficients of lags 1 and 13 are significant at the 10 percent level. Lags 14 and 15 are not significant. All coefficients of UF have negative signs and the coefficients of the remaining lags—lags 2 to 12—are statistically significant. The evidence presented in Table 1 shows that both anticipated and unanticipated fiscal policy have lasting impact on real output, and that anticipated policy has a greater impact than unanticipated policy.

In the case of the monetary policy, Table 1 indicates that anticipated monetary policy has a longer run impact on real output. The sum of the coefficient of AM is significant at the 5 percent level. Unanticipated monetary policy has only a short run, temporary impact on real output. However, in contrast to fiscal policy measures, both anticipated and unanticipated money growth has a significant and positive contemporaneous effect on real output. In addition, coefficients of lags 1 to 3 of AM are significant at the 5 percent level, and lags 4 to 6 are significant at the 10 percent level. The coefficients of the remaining lags of AM are positive but are not statistically significant. On the other hand, only the current and lag 1 of unanticipated monetary policy is significant. Lags 4 to 15 are negative.

The statistical inference that can be drawn from the results given in Table 1 is that anticipated and unanticipated fiscal policy and anticipated monetary policy are not neutral in affecting the growth rate of output. However, the effect of unanticipated money on growth rate of real output is not statistically significant.
CONCLUSION

The major innovation of this paper is to jointly estimate the effects of anticipated and unanticipated monetary and fiscal policies on real output. Previous studies had analyzed the impact of either monetary or fiscal policy, but not both, on real output. The results of this paper are broadly consistent with previous studies which have estimated the effects of anticipated and unanticipated policy actions on real output. Laumans and McMillin [8] found that both anticipated and unanticipated fiscal actions have expansionary effects upon real output while Mishkin [14] found that both anticipated and unanticipated monetary growth have positive short-run effects on real output. Makin [13], however, found a significant effect of anticipated monetary growth on real output but little evidence of significant effects of unanticipated money growth on real output. This paper supports prior studies in finding that anticipated and unanticipated fiscal policy, as well as anticipated monetary policy, expand output. It also supports the prior mixed findings regarding the effects of unanticipated monetary growth on real output.

The evidence presented in this paper has, therefore, shed new light on the issues of Macro Rational Expectations and the "policy ineffectiveness" debate. The evidence tends to reject the hypothesis that discretionary economic policy (monetary and fiscal) is ineffective in affecting the growth rate of output.

NOTES

1. McCallum, however, examines only the effects of unanticipated policy actions on real output growth.

2. McCallum and Whited [11] have shown that within the context of a B栏e-pricing rational expectations" macro-model, built in stabilizers automatically provide reaction to current shocks and thereby affect real output in the current period. Thus, in selecting a fiscal policy measure, one must avoid contaminating this response with changes in expenditures or tax receipts due to the automatic stabilizers aspects of fiscal policy. For this reason the measure described in the text was selected.

The hypothesis that quarterly real GNP has a first-order unit root could not be rejected. Thus following Makin [13], difference stationary variables—growth rate of output—is employed.

3. Data for the cyclically-adjusted deficit, the rate of inflation (rate of change in the implicit GNP deflator), nominal GNP, the unemployment rate, the implicit deflator for imports, the three-month Treasury bill rate, M2, real net exports, price commercial paper rate, net exports, balance-of-payments, and trade-weighted exchange rate of the dollar are from Chain Link data tape. Data for real GNP were constructed from nominal GNP and the implicit GNP deflator. Data for middle-term trend GNP are from Hallower [7] and extend to 1982:2 using the method described by Hallower. Publicly held Federal debt data were provided by the Federal Reserve Bank of St. Louis.

4. To save space estimates of equations (3) and (2) are not presented.

5. For the anticipated money supply equation the calculated F-statistic is 0.58, the actual F-statistic (5% level) is approximately 1.70. For the anticipated fiscal policy equation the calculated F-statistic is 0.01 while the critical F-statistic (5% level) is approximately 1.55. These are the values when the sample was split in 1973.1. The autoregression tested for first through fourth order serial correlation None of the coefficients of the lagged residuals for either equation was significant.

6. The correlation among policy variables is given below:

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REFERENCES

