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ABSTRACT

The effects of the October 1979 change in monetary policy on the economy in 1980-1981 are estimated in this paper. The effects are estimated from simulations with my model of the U.S. economy. Standard errors of the estimated effects are also presented. The results indicate that the change reduced real growth, but had little effect on the rate of inflation.

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by

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On October 6, 1979, the Federal Reserve announced what most people interpreted as a change in monetary policy. The purpose of this paper is to estimate the effects of this change on the 1980-1981 economy. The effects of the change are estimated from simulations with my model of the U.S. economy (1976, 1980b). One of the equations in this model, which is discussed in detail in my (1978b) paper, is an equation explaining the behavior of the Federal Reserve. In this equation the Fed is estimated to "lean against the wind," i.e., to allow short term interest rates to rise (fall) in response to an increase (decrease) in real economic activity, in the rate of inflation, and in the past growth rate of the money supply. The change in monetary policy is estimated by adding three dummy variables to this equation: one each for 1979IV, 1980I, and 1980II. The estimated coefficients of these variables are taken to be the estimated effects of the monetary policy change on short term interest rates.

To estimate the effects of the policy change on the economy, two dynamic simulations were run for the 1979IV-1981IV period: a "base" run that included the Fed behavioral equation with the dummy variables, and a second run that included the equation without the dummy variables. The difference between the predicted values from these two runs for each endogenous variable and each quarter is an estimate of the effect of the policy change on the variable in the quarter. Standard errors of the effects have also been estimated, and these are presented below. The standard errors were estimated by means of a stochastic simulation procedure that I have recently proposed (1980a).

I. The Equation Explaining Fed Behavior

The equation explaining Fed behavior, estimated for the 1954I-1980II period by two stage least squares, is:

$$\begin{aligned}(1)\qquad r_t = & \underset{(3.97)}{-13.4} + \underset{(16.77)}{0.874}\, r_{t-1} + \underset{(1.87)}{0.0512}\, \%PD_{t-1} + \underset{(3.96)}{0.0421}\, J^*_t \\ & + \underset{(2.16)}{0.0557}\, \%GNPR_t + \underset{(1.52)}{0.0188}\, \%GNPR_{t-1} + \underset{(2.47)}{0.0324}\, \%M_{1t-1} \\ & + \underset{(3.35)}{1.58}\, D794_t + \underset{(3.02)}{1.59}\, D801_t - \underset{(3.78)}{2.22}\, D802_t\ ,\end{aligned}$$

$$\hat{\rho} = \underset{(2.16)}{0.246}\ , \quad SE = 0.444\ , \quad R^2 = 0.965\ , \quad DW = 1.82\ ,$$

where r is the three month Treasury bill rate, $\%PD$ is the percentage change at an annual rate in the price deflator for domestic sales, J^* is a measure of labor market tightness, $\%GNPR$ is the percentage change at an annual rate in real GNP, $\%M_1$ is the percentage change at an annual rate in the money supply, and $D794$, $D801$, and $D802$ are dummy variables that take on a value of one in the relevant quarter (1979IV, 1980I, and 1980II, respectively) and zero otherwise. $\hat{\rho}$ is the estimate of the first order serial correlation coefficient. t-statistics in absolute value are in parentheses. A description of the data and the precise definitions of the variables are contained in (1976, 1980b).

Equation (1) states that the current bill rate is a positive function of the lagged rate of inflation, of the current degree of labor market tightness, of the current and lagged rates of growth of real GNP, and of the lagged rate of growth of the money supply. Lagged values of these variables also have an effect on the current bill rate because of the inclusion of the lagged dependent variable in the equation. The estimated effects of the policy change on the bill rate in the three quarters are 1.58, 1.59, and -2.22. In other words, the Fed is estimated to have allowed the bill rate to be higher in 1979IV and 1980I (by 1.58 and 1.59 percentage points, respectively) and lower in 1980II (by 2.22 percentage points) than it would have had it been following its old policy rule.

It is important to note in interpreting these effects that they are conditional on the lagged value of the bill rate. In 1979III, for example, the bill rate was 9.63, and given this value and the values of the other explanatory variables in equation (1) for 1979IV, the Fed is estimated to have allowed the bill rate to be 1.58 percentage points higher in 1979IV than it would have under the old rule. In 1979IV the bill rate was 11.80, and given this value and the other values for 1980I, the estimated effect on the bill rate in 1980I is 1.59 percentage points. Finally, in 1980I the bill rate was 13.46 and given this value and the other values for 1980II, the Fed is estimated to have allowed the bill rate to be 2.22 percentage points lower in 1980II than it would have under the old rule. (The bill rate in 1980II was 10.05.)

For purposes of the simulation work below it is assumed that the Fed has gone back to its old policy rule starting in 1980III. The policy change is thus assumed to have lasted only three quarters. When more data are available, this assumption can be tested by adding further dummy variables to equation (1) and seeing if their coefficient estimates are significant. Some of the statements of the Chairman of the Federal Reserve in July 1980 are consistent with this assumption, in particular his testimony before the Senate Banking Committee on July 22, 1980.

II. The Model

The model is described elsewhere (1976, 1980b), and so it will only be briefly discussed here. The current version consists of 97 equations, 29 of which are stochastic, and has 183 unknown coefficients to estimate, including 12 first order serial correlation coefficients. Equation (1) is part of the model. The model is nonlinear in both variables and coefficients. For present purposes it has been estimated by two stage least squares. The sample period for these estimates was 1954I-1980I except for the estimate of equation (1), where it was 1954I-1980II. The covariance matrix of the estimated coefficients, which is needed for the stochastic simulation results, was estimated using formula (4) in Fair and Parke (1980, p. 273). This matrix, which is of dimension 183x183, is not block diagonal. Included among the 183 coefficients are the three dummy variable coefficients in equation (1).

The model has two important properties that should be kept in mind in interpreting the following results. First, interest rates have, other things being equal, a positive effect on prices. In the theoretical version of the model, which is based on the premise that firms set prices (along with other decision variables) by solving multiperiod maximization problems, the interest rate and other cost of capital variables have a positive effect on the price that the firm sets. This feature is also part of the econometric model: included among the explanatory variables in the price equation are two cost of capital variables, a bond rate and an investment tax credit variable. The second property is that prices are not very sensitive to demand changes except in periods of high economic activity. In other words, the tradeoff between output and inflation is very poor in periods of low to moderate economic activity. This feature, which appears to be common to many other econometric models as well, is discussed in detail in my (1978a) paper.

It should also be noted that interest rates have a strong negative effect on demand and output in the model. There are a number of channels for this effect. The two long term interest rates in the model, a bond rate and a mortgage rate, are linked to the bill rate through standard term structure equations. Both the bill rate and the mortgage rate appear directly as explanatory variables in the consumption equations, with negative coefficient estimates. Because of this, the household savings rate is, other things being equal, a positive function of interest rates. The bond rate affects prices, as mentioned above, and prices have, other things being equal, a negative effect on demand. (Prices appear as explanatory variables in the consumption equations, with negative coefficient estimates.) There is also a loan-constraint variable in the model. This variable is a function of the level of interest rates and has a negative effect on consumption in periods of tight money. Interest rates also have a negative effect on wealth in the model, through a negative effect on stock prices, and wealth has a positive effect on consumption. Demand affects output in the model, which in turn affects investment and employment; and so interest rates, by affecting demand, indirectly affect output, investment, and employment.

III. The Estimated Effects

The results for eight endogenous variables in the model are presented in Table 1. The values in the a rows for each variable are actual values for 1979IV-1980II and predicted values thereafter. The actual values for 1980II are preliminary (they are values available as of August 1, 1980). The predicted values are from an *ex ante* forecast that I made on August 7, 1980, with the model.

The values in the b rows are the estimated effects of the policy change on the variables. It will be easiest to describe how these values would have been obtained had deterministic simulations been used and then to explain the modifications needed for the stochastic simulations. First, estimated residuals are available for the first three quarters (1979IV-1980II), and these residuals were added to the estimated equations and treated as exogenous. This means that a perfect tracking solution is obtained for these quarters when the actual values of the exogenous variables (including the dummy variables in equation (1)) are used. Since the predicted values beyond 1980II are based on actual values for 1980II, this also means that a simulation run from 1979IV through the end of the forecast period (1981IV) will duplicate the predicted values for 1980III and beyond, provided that the actual values of the exogenous variables are used for the first three quarters and that the exogenous-variable values used for the *ex ante* forecast are used thereafter. Call this simulation the "base" simulation.

A second simulation can then be run that is identical to the base simulation except that the values of the dummy variables in equation (1) are set equal to zero. This run is an estimate of what the economy would have been like had the monetary policy change for the three quarters not

TABLE 1

Estimated Effects of the Monetary Policy Change on Eight Variables

a rows: actual values through 1980II, predicted values thereafter.
b rows: estimated effects of the policy change (mean values from 150 draws).
c rows: standard errors of the estimated effects.

Variable		1979 IV	1980 I	1980 II	1980 III	1980 IV	1981 I	1981 II	1981 III	1981 IV	Sum over the 9 Quarters
Bill Rate (percentage points)	a	11.80	13.46	10.05	9.27	9.16	9.13	9.12	9.16	9.24	
	b	1.60	2.87	0.17	0.08	0.03	-0.02	-0.06	-0.09	-0.11	
	c	0.47	0.75	0.82	0.66	0.52	0.41	0.32	0.25	0.19	
Real GNP (billions of 1972 dollars)	a	1441.7	1446.7	1414.3	1416.9	1423.1	1432.4	1443.1	1455.6	1469.2	
	b	-1.5	-6.5	-10.3	-8.0	-7.5	-7.1	-6.6	-6.0	-5.4	-58.8
	c	0.7	2.6	4.8	5.2	6.0	6.7	7.2	7.4	7.4	45.1
Percentage Change in Real GNP (percentage points)	a	2.35	1.39	-8.66	0.72	1.76	2.65	3.04	3.61	3.78	
	b	-0.42	-1.40	-1.03	0.66	0.14	0.14	0.15	0.18	0.20	
	c	0.19	0.57	0.67	0.71	0.36	0.29	0.22	0.18	0.16	
Percentage Change in GNP Deflator (percentage points)	a	7.92	9.30	9.93	9.29	10.27	9.10	8.94	8.76	9.64	
	b	0.19	0.10	-0.34	0.06	0.09	-0.00	-0.02	-0.02	-0.03	
	c	0.10	0.17	0.17	0.12	0.06	0.05	0.05	0.05	0.09	
Percentage Change in Money Supply (percentage points)	a	7.72	0.31	0.00	8.53	8.54	8.55	8.58	8.61	8.72	
	b	-0.91	-1.35	0.03	0.09	0.10	0.12	0.14	0.15	0.15	
	c	0.33	0.46	0.51	0.44	0.32	0.23	0.16	0.11	0.09	
Private Sector Employment, establishment data (thousands of jobs)	a	88253	88704	87581	86947	86843	87043	87382	87827	88359	
	b	-31	-159	-332	-386	-392	-394	-393	-384	-368	
	c	15	70	154	209	257	304	345	377	400	
Civilian Unemployment Rate (percentage points)	a	5.84	6.11	7.43	8.02	8.18	8.12	7.97	7.81	7.65	
	b	0.03	0.16	0.33	0.34	0.31	0.27	0.24	0.22	0.19	
	c	0.01	0.07	0.15	0.18	0.20	0.22	0.24	0.24	0.24	
Corporate Profits, before tax (billions of current dollars)	a	207.8	222.0	165.2	186.2	196.6	200.8	210.9	221.3	232.7	
	b	-0.5	-5.7	-11.2	-5.9	-4.3	-3.4	-2.6	-1.7	-0.9	-36.1
	c	0.7	3.1	5.7	4.7	5.0	5.2	5.2	5.0	4.9	34.8

been undertaken. The difference between the values from these two runs for each endogenous variable and each quarter is an estimate of the effect of the policy change on the variable in the quarter. These differences would be the values of the b rows in Table 1 if deterministic simulations had been used. The modifications for the stochastic simulations will now be described.

The differences between the values from the above two runs are uncertain because they are based on estimated values of the coefficients rather than the (unknown) actual values. In a recent study (1980a) I have proposed a stochastic simulation procedure that can be used to estimate this uncertainty. The procedure in the present case consists of drawing sets of coefficient values from an estimate of the distribution of the coefficient estimates and for each set running the above two simulations. If, say, 100 draws are made, then one has 100 estimates of each difference. These 100 estimates can then be used to compute the mean and standard error of each difference. For the results in Table 1, 150 draws were made, using the above mentioned covariance matrix of the coefficient estimates for the draws. The b-row values are the estimated means (over the 150 values for each variable and each quarter) of the differences, and the c-row values are the estimated standard errors of the differences.

The a-row values are subject to change in the future. Many of the "actual" values for the first three quarters will be revised, and the predicted values for the remaining quarters are not likely to be exactly right (even using my model). Fortunately, the b- and c-row values are not likely to be sensitive to the a-row values, and more confidence can be placed on them than on the a-row values. Because the model is nonlinear, the multipliers in the b rows are a function of the a-row values (i.e., of the initial conditions, the exogenous-variable values, and the realizations of the error terms), but for most macroeconometric models the effects of the a-row values on the b-row values are small relative to the size of the b-row values.

Given the above discussion of the properties of the model, the b-row results in Table 1 should be as expected, namely that the policy change affected output negatively but had little effect on the rate of inflation. According to the demand pressure variables in the model , the policy change was not made in a period of high economic activity. The unemployment rate in 1979III was 5.8 percent, and real GNP growth during the previous four quarters (1978IV through 1979III) had been only 1.8 percent. (The growth rate in 1979III was 3.2 percent at an annual rate.) The estimated effect on real GNP in 1980II is -10.3 billion dollars, and the cumulative effect over the 9 quarters is -58.8 billion dollars. The estimated effect on the percentage change in the GNP deflator is -0.34 percentage points in 1980II and -0.03 percentage points by the end of the period. The rate of inflation is actually higher in the first two quarters (and in 1980III and 1980IV), which is due to the positive interest-rate effect on inflation outweighing the negative demand-pressure effect. All the b-row values for inflation are, however, very small, and the main conclusion from them is that the policy change had very little effect on inflation in either direction.

As a consequence of the fall in output, about 400 thousand jobs are lost by the end of 1980, and the unemployment rate is about 0.3 percentage points higher. The cumulative fall in corporate profits over the 9 quarters is 36.1 billion dollars. The money supply grows less in the first two quarters and then slightly more for the rest of the period. Although not shown in the table, the cumulative fall in the money supply over the 9 quarters is 17.2 billion dollars (with a standard error of 13.7 billion dollars).

The standard errors in the c rows give one a rough idea of how much confidence to place on the b-row values. For the first two or three quarters the standard errors are generally less than half of the estimated effects. By the end of the period they are generally greater than the estimated effects.

The standard errors in Table 1 are based on the implicit assumption that the model is correctly specified: the estimated uncertainty of the multipliers is due only to the uncertainty of the coefficient estimates. In the present case there are at least two reasons for believing that the uncertainty of the multipliers is greater than the estimates in the table. First, the model may not have captured adequately the effects of the credit controls that were imposed during part of the 9 month period. There is a loan-constraint variable in the model, and in principle this variable should have captured these effects. It may be, however, that the effects were underestimated. The decline in real GNP in 1980II (of 8.7 percent, preliminary estimate), for example, was considerably underestimated by the model. The model predicted (*ex post*) a fall of only 1.4 percent for the one-quarter-ahead forecast and 1.2 percent for the three-quarter-ahead forecast (i.e., the forecast beginning in 1979IV). Some of this error may have been due to a failure to capture all the effects of the controls. If so, this means that the output effects in Table 1 should be larger (i.e., more negative). The inflation effects, however, are not likely to be affected very much, given that output has little effect on inflation in this period. (The *ex post* forecasts of inflation are fairly accurate. The GNP deflator increased by 9.93 percent in 1980II. The one-quarter-ahead forecast was 11.38 percent, and the three-quarter-ahead forecast was 10.53 percent.)

The other reason for questioning the uncertainty estimates in Table 1 concerns the foreign sector in the model. In the current version exports and import prices are exogenous, and so foreign repercussions of the monetary policy change are not accounted for. It may be, for example, that an increase in the short term U.S. interest rate results in an appreciation of the dollar (depending on how the monetary authorities of other countries respond to the increase in the U.S. rate). This will likely result in a fall in U.S. import prices and then over time to a fall in U.S. domestic prices. If this effect is in operation, it means that the effects on inflation of the policy change have been underestimated by the model. Some preliminary work that I have done constructing a multicountry econometric model indicate that this effect is probably small, in part because other countries' short term interest rates respond to the U.S. rate.

IV. Conclusion

The main result of the simulations is easy to summarize. The change in monetary policy is estimated to have reduced real growth without having much effect on the rate of inflation. Real growth was reduced because interest rates have a negative effect on demand and output. Inflation was not affected very much because the tradeoff between output and inflation is very poor in periods of low to moderate economic activity. There is also an offset to the negative demand-pressure effect on inflation in this case, namely a positive interest-rate effect. The possible misspecification of the model is likely to affect the output multipliers more than the inflation multipliers. In particular, because of the credit controls, the policy change may have had a larger effect on output than is estimated in Table 1.

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