On Modeling the Effects of Government Policies

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An important question in macroeconomics is how government policies affect the economy. The fact that this question is still being debated forty-three years after John Maynard Keynes wrote *The General Theory* and thirty-nine years after Jan Tinbergen did his pioneering econometric study of business cycles for the League of Nations indicates the difficulty of answering it. Although it is easy to construct theoretical models in which government policies do or do not have important effects on, say, real output, it is difficult to test alternative models. One difficulty is the relative ease with which aggregate time-series data can be fit well within the sample period. Because of this, a good within-sample fit is by no means a guarantee that the particular equation or model is a good representation of the actual process generating the data. It is also difficult to make comparisons of predictive accuracy across models because of differences in the number and types of variables that are taken to be exogenous. These difficulties are annoying and have undoubtedly contributed to giving macroeconomics a bad name.

The purpose of this paper is to review that part of my recent work that relates to modeling the effects of government policies. In my econometric model, government actions, even if they are anticipated, can have important effects on real output, and in Section I the theoretical basis for this property is reviewed. In Section II the sensitivity of policy effects in the model to a number of alternative assumptions is examined. These assumptions concern 1) the behavior of the Federal Reserve, 2) whether or not there are rational expectations in the bond and stock markets, and 3) whether or not government bonds are treated as wealth by the household sector. In Section III the testing of the model is discussed. Two types of tests are considered in this section: tests of individual hypotheses and tests of the accuracy of the overall model. The main points of the paper are summarized in Section IV.

I. Theoretical Issues

The proposition that government tax rates and transfer payments affect the decisions of households and firms is familiar from micro-economics. In the theoretical model upon which my econometric model is based (see the author, 1974, 1976), the "micro-economic" aspect of individual decisions has been stressed. The decisions of the individual agents in the model (households, firms, and banks) are derived from the solutions of multiperiod optimization problems. At the beginning of each period each agent solves its optimization problem, knowing all past values, receiving in some cases information from others regarding certain current-period values, and forming expectations of future values. A number of government policy variables affect the solutions of these problems, and so through this channel government actions affect the economy. Tax rates and transfer payments, for example, affect the labor-leisure choice of the utility-maximizing households.

Although these micro-economic effects are fairly well accepted in the profession, they do not exist in a popular class of rational expectations macro models (see Robert J. Barro, Robert E. Lucas, Jr., Thomas J. Sargent, 1973, 1976, and Sargent and Neil Wallace). Elsewhere (1978b), I have criticized this class of models for postulating that individuals are rational with respect to their expectation formation but not rational with respect to their overall behavior. This is an important criticism of these models in that their key property regarding the ineffectiveness of anticipated government actions on real output

no longer holds if rationality with respect to overall behavior is introduced into the models. In a "completely" rational model the government can affect real output by affecting, among other things, the labor-leisure choice of households.

There is also in my theoretical model another reason government actions can affect the economy. The model allows for the existence of disequilibrium, and if there is disequilibrium, the government can, by conventional means, help to correct it. Disequilibrium takes the form of banks constraining firms and households in how much money they can borrow at the current loan rates and of firms constraining households in how much they can work at the current wage rates. Binding constraints in the loan market are due to mistakes on the part of banks in setting loan rates, and binding constraints in the labor market are due to mistakes on the part of firms in setting prices and wages. These mistakes are the result of expectation errors. No agent knows the complete model, and so expectations can turn out to be wrong even though there are no random shocks in the model. There is, however, a continual adjustment to past mistakes in that each period the individual agents form a new set of expectations and reoptimize on the basis of information from the previous period.

The key premise of my theoretical work is thus that agents each period first form a set of expectations of future values and then given these expectations base their decisions on the solutions of multiperiod optimization problems. The expectations may be in error, and so banks and firms may set values of loan rates, wages, and prices that are not market clearing. Both the micro-economic and disequilibrium aspects of this premise imply that the government can affect real variables in the economy.

One important difference between my theoretical model and a disequilibrium model like that of Barro and Herschel Grossman should be noted. In the Barro-Grossman model, prices and wages are not decision variables of firms (or any other agents), and no explanation is provided as to why it is that

prices and wages may not always clear markets. In my model, on the other hand, such an explanation is provided, namely the possibility of expectation errors on the part of firms. In short, my model, unlike Barro and Grossman's, is "choice theoretic" with respect to the determination of prices and wages. Because of this weakness of the Barro-Grossman model, Grossman is now advocating another theory of employment fluctuations, a theory in which market transactions are viewed as involving implicit contractual arrangements for mitigating risk.

II. The Sensitivity of Policy Effects to Alternative Assumptions

The properties of macro-econometric models tend to be sensitive to alternative assumptions. Given the difficulty of testing assumptions, this means that any policy recommendations that result from analyzing a model must be interpreted with considerable caution. Some assumptions are, however, more important than others in this regard, and the purpose of this section is to review the sensitivity results that I have obtained with my model.

Fiscal policy effects in the model are, as reported in my 1978a paper, quite sensitive to assumptions about monetary policy. The results of five experiments are presented here. Each experiment corresponded to the same fiscal policy shock (an increase in government purchases of goods). For four of the experiments the behavior of the Fed was assumed to be exogenous: in each of these cases the Fed was assumed to control a particular variable, which was then taken to be exogenous for the experiment. (By exogenous here is meant that for the experiment the variable was kept unchanged each period from its base-simulation value.) The control variables in the four cases were: 1) the amount of government securities outstanding; 2) the money supply; 3) nonborrowed reserves; and 4) the bill rate. For the fifth experiment the Fed was assumed to behave according to an estimated equation. The behavior that is reflected in this equation is behavior in which the Fed "leans against the wind." As the economy expands or as

inflation increases, the Fed is estimated to cause interest rates to rise.

The results of these experiments are briefly as follows. When the Fed behaved according to the estimated equation, the sum of the increase in real output over the first twelve quarters after the fiscal policy change was 61 percent of the sum when the bill rate was kept unchanged. When the money supply was kept unchanged, the sum was 45 percent of the sum in the constant bill-rate case. The most expansionary case was the one in which the amount of government securities outstanding was kept unchanged. In this case the government deficit that results from the fiscal policy change is financed by an increase in high powered money. The sum in this case was 107 percent of the sum in the constant bill-rate case. Finally, the sum in the case in which nonborrowed reserves was kept unchanged was 72 percent of the sum in the constant bill-rate case. In short, these results indicate that fiscal policy effects are quite sensitive to what is assumed about Fed behavior.

Policy effects in the model are also sensitive to what is assumed about expectations in the bond and stock markets. In my forthcoming paper I have examined policy effects in three versions of the model: 1) the regular version (Model 1), in which expectations of future interest rates and stock prices are not rational; 2) a version (Model 2) in which expectations of future interest rates are rational; and 3) a version (Model 3) in which expectations of future interest rates and stock prices are rational. The fiscal policy shock described above was used, and the Fed was assumed to behave according to the estimated equation mentioned above.

The results for these three versions of the model are as follows. For Model 2 the sum of the increase in real output over the first twelve quarters after the fiscal policy change was 57 percent of the sum for Model 1. In Model 2 people know that the Fed is going to respond to the fiscal policy stimulus by increasing interest rates in the future, and this information gets incorporated immediately into long-term rates. In Model 1, on the other hand, long-term rates adjust only to the current and lagged increases in the short rate.

Higher long-term rates have, other things being equal, a contractionary effect on the economy, and this is the main reason for the smaller increases in real output in Model 2 than in Model 1. For Model 3 the sum of the output increase was 61 percent of the sum for Model 1. In Model 3 people also know that profits are going to be higher in the future as a result of the stimulus, and this information gets incorporated immediately into stock prices. Stock prices are thus higher in Model 3 than they are in Model 2, and this leads, through a wealth effect on the household sector, to a slightly more expansionary economy in Model 3 than in Model 2. This difference is, however, much smaller than the difference between the results for Models 1 and 2, and so in this sense expected future profits in the model are less important than expected future interest rates.

The experiment just described was an unanticipated fiscal policy change. I also ran an experiment in which the change was announced thirteen years before it was actually made. In this case in Models 2 and 3 (but not in Model 1) people begin to adjust to the higher expected future interest rates and profits before the change is actually made. For Model 3 the sum of the change in output between the time of the announcement and twelve quarters after the change was actually made was 29 percent of the sum for Model 1. The anticipated policy change was thus about half as stimulative as the unanticipated change (29 vs. 61 percent).

Although the results just described are clearly tentative and are in no way a test of the assumption of rational expectations, they do indicate that this assumption is of considerably quantitative significance in macroeconometric models.

For purposes of the present paper I have also examined the sensitivity of policy effects to the treatment of government debt as wealth by the household sector. The wealth of the household sector is an explanatory variable in the four consumption equations in the model and in one of the three labor supply equations. In the regular version of the model government debt is included in this wealth variable. For an alternative version I reestimated the

five equations with government debt subtracted from the wealth variable. I then applied the same fiscal policy shock described above to this version (with the Fed behaving according to the estimated equation). The results from this exercise are easy to summarize. First, the fits of the five equations in the alternative version were almost identical to the corresponding fits in the regular version. It is clear that the macro data are not adequate for discriminating between these two versions of the model. Second, and for once fortunately, the policy properties of the two versions are quite similar. In other words, policy effects in the model are not sensitive to whether or not government debt is treated as wealth by the household sector. The sum of the increase in output over the twelve quarters in the alternative version was 98 percent of the sum in the regular version.

III. Tests of the Model

Given that my model does allow for anticipated government actions to have effects on real output, it is of considerable interest to test this model against models that do not allow for these effects. In this section the tests of the model that I have performed will be reviewed.

There are, first of all, t-tests of the individual coefficient estimates. A number of the explanatory variables in the consumption and labor supply equations that one expects from micro-economic theory to affect the decisions of households are significant by conventional standards. In addition, the "disequilibrium" variable that I have used to try to account for possible work constraints on the household sector is significant in a number of the equations. One must, of course, be skeptical of t-tests because of the ease with which good t-values can be obtained in macro data and of the general problem of data mining, and the purported significance of my micro-economic and disequilibrium explanatory variables is no exception to this. At least with respect to the disequilibrium variable, however, it does seem unlikely to me that the results would be as they are if there were no disequilibrium effects in the economy. The variable (ZJ)

appears in the four consumption equations and in two of the three labor supply equations, with t-values for the most recent set of estimates, (see my 1978e paper), of 1.49, 3.37, 4.43, 2.17, 3.92, and 2.36.

With respect to possible tests of the assumptions examined in the previous section, I have already mentioned that it seems unlikely that the data are adequate for testing the hypothesis that government debt is treated as wealth by households. It may, on the other hand, be possible to test the hypothesis of rational expectations in the bond and stock markets, although this is by no means a straightforward exercise. I have outlined in my forthcoming paper (fn. 13) one possible way in which this hypothesis might be tested. Regarding the assumption about Fed behavior, the equation that I have estimated to explain Fed behavior seems quite good by conventional statistical standards, although again conventional tests of individual equations must be interpreted with considerable caution.

Tests of the significance of individual coefficient estimates do not allow one to test one model against another (unless the models are nested). I have, however, recently proposed a method for estimating the uncertainty of a forecast from an econometric model that allows one to make comparisons of predictive accuracy across models (see my 1978c paper), and I have applied this method to three other models besides my own (1978d). The three other models are the classical macro-econometric model of Sargent (1976), the six-equation unconstrained vector autoregression model of Chistopher A. Sims, and a "naive" model in which each variable is regressed on a constant, time, and its first eight lagged values. These three models have quite different policy implications from mine, and so estimating the accuracy of my model against these provides one test of the hypothesis that anticipated government actions affect real variables. In Sargent's model anticipated government actions have no effect on real output, and in Sims' model and in the naive model there are no exogenous variables.

Space limitations prevent a detailed discussion of the method of comparison. The

method accounts for the four main sources of uncertainty of a forecast: uncertainty due to 1) the error terms, 2) the coefficient estimates, 3) the exogenous variable forecasts, and 4) the possible misspecification of the model. It is based on successive reestimation and stochastic simulation of the model. Because it accounts for all four sources, it can be used to make comparisons across models.

A sampling of the comparison results is as follows. For real *GNP* the estimated standard errors of the eight-quarter-ahead forecast, taking into account all four sources of uncertainty, are 4.74 percent for the naive model, 5.10 percent for Sargent's model, 7.79 percent for Sims' model, and 2.27 percent for my model. For the eight-quarter-ahead forecast of the *GNP* deflator the corresponding estimated standard errors are 6.20, 8.53, 6.26, and 3.48 percent; and for the eight-quarter-ahead forecast of the unemployment rate the corresponding errors in percentage points are 2.19, 1.88, 2.23, and 0.71. Although these results are quite tentative, they do seem to indicate that my model is more accurate than the other three with respect to these three variables. So as not to leave the impression that I feel I have found the ultimate model, it should also be pointed out that my model is not as accurate as either the naive model or the Sims model with respect to forecasts of the money supply. The estimated standard errors for the eight-quarter-ahead forecast are 3.70 percent for the naive model, 6.79 percent for Sims' model, and 7.50 percent for my model. (The money supply is exogenous in Sargent's model.) Also, my model is not as accurate as the naive model with respect to forecasts of the nominal wage rate. The estimated standard errors for the eight-quarter-ahead forecast are 2.04 percent for the naive model, 5.69 percent for Sims' model, and 4.16 percent for my model. (The wage rate is not a variable in Sargent's model.)

V. Summary and Conclusion

The main points of this paper can be summarized as follows:

1. There is strong theoretical justification from microeconomics for the proposition that even anticipated government actions affect real variables. On a macro-economic level this proposition has received some support in my work in the sense that a number of "micro-economic" explanatory variables are significant in my estimated equations.

2. The possible existence of disequilibrium in the economy provides another justification for the effectiveness of government policies. The proposition that disequilibrium at times exists in the economy has received some support in my work through the significance of my "disequilibrium" variable (ZJ).

3. Policy effects in my model are sensitive to assumptions about Fed behavior and about expectations in the bond and stock markets. They are not sensitive to whether or not government debt is treated as wealth by households. It may be possible in the future, as outlined in my forthcoming paper, to test the assumption of rational expectations in the bond and stock markets, but it is unlikely that the macro data can be used to decide how government debt is treated by households. The equation that I have estimated to explain Fed behavior, an equation in which the Fed is estimated to lean against the wind, appears to be good when judged by conventional statistical standards.

4. A method that I have proposed for estimating the expected predictive accuracy of econometric models indicates that my model is more accurate than Sargent's model, Sims' model, and a naive model with respect to forecasts of real *GNP*, the *GNP* deflator, and the unemployment rate. These results thus provide some tentative support for the proposition that even anticipated government actions can affect real variables.

To conclude, it is interesting to speculate what the status of the debate about the effectiveness of government policies will be forty-three years from now in 2021. By this time 172 more quarterly observations will have been generated, and my hope is that the use of these additional data and methods like the one I have proposed for comparing models will have considerably narrowed the range of disagreement. At the least, one would hope that we will have advanced beyond the point where the best model available is only fair.

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