EDITOR'S NOTE:

The following two articles have evolved from the article, titled "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," presented in the November 1968 issue of this REVIEW. *Frank de Leeuw is now a Senior Staff Member at the Urban Institute in Washington, D.C. and was formerly Chief of the Special Studies Section, Division of Research and Statistics at the Board of Governors of the Federal Reserve System. John Kalchbrenner is an economist in the Special Studies Section, Division of Research and Statistics at the Board of Governors. Their "Comment" presents several important considerations for the reader, and tends to emphasize the volume of work remaining for economists and analysts interested in the current discussion of the role of money and monetary policy.*

The "Reply," by Leonall C. Andersen and Jerry L. Jordan, attempts to clarify the areas of disagreement between them and the authors of the "Comment." In many instances, clarification consists of answering the specific questions about their model and reinforcing their original position, rather than adjusting any of the theory and procedures behind the model.

Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization – Comment

by FRANK DE LEEUW and
JOHN KALCHBRENNER[1]

A RECENT ARTICLE by Andersen and Jordan answers many of the criticisms of earlier single-equation studies of the relation between money and income.[2] It makes use of distributed lags instead of fixed-point lags. It uses high-employment Federal receipts and expenditures instead of actual receipts and expenditures. It represents monetary policy by the monetary base as well as the money supply. These technical improvements should make their conclusion that fiscal policies have no perceptible effect on GNP movements all the more disturbing to those of us who have been inclined to believe that fiscal policies have powerful effects on income.

The purpose of this "Comment" is to examine whether these conclusions hold up under a careful examination of the statistical requirements of single-equation models and their presence or absence in the Andersen-Jordan equations. We are led, in the course of the examination, to try some alternative equations with important differences in results. The alternative equations seem to us to cast considerable doubt on the Andersen-Jordan skepticism about fiscal policy.

The Statistical Requirements of Single-Equation Models

Two different ways of describing the St. Louis equations bring into focus the central problem that has concerned us. One way to describe the equations is to say that they are attempts at using multiple regression to measure the influence on GNP of certain exogenous government policy variables. By exogenous we here mean variables that can be heavily and directly influenced by policymakers. Variables which are not easily influenced by policymakers are not particularly useful ones to have in a regression, except as they reduce uncertainty about the coefficients of the policy variables.

A second way to describe the St. Louis equations is that they are reduced forms of some underlying more complex model of the economy. In any model of this kind the current endogenous variables – the ones the model attempts to explain – depend on past

[1]We wish to thank the staff of the Federal Reserve Bank of St. Louis, especially Messrs. Andersen and Jordan, for supplying us with data and for making the pages of the *Review* available to us. This "Comment" was first presented at a seminar at the Federal Reserve Board on January 16, 1969, and was followed by a lively and helpful discussion by Messrs. Andersen, Jordan and other colleagues in the Federal Reserve System. Responsibility for the statements in this "Comment" rests, of course, solely with the authors.

[2]This article, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," by Leonall C. Andersen and Jerry L. Jordan, appeared in the November 1968 issue of this *Review*, pp. 11-24.

values of the endogenous variables and on the exogenous variables. By exogenous we now mean variables which do not respond to current movements in the endogenous variables.[3] By solving for the past endogenous variables, we can in principle reduce the system to a relation between each current endogenous variable and current and lagged exogenous variables. A linear relation between GNP and exogenous variables is a simple approximation to such a reduced-form relationship. Relations between the general price level and exogenous variables or some interest rate and exogenous variables would be other reduced-form relationships. From a statistical viewpoint, the assumption that the exogenous variables do not respond to movements of the endogenous variables is crucial. For if we call exogenous in a GNP equation some "X" which itself strongly responds to current economic developments, we don't know whether we are measuring the influence of "X" on the economy, the economy on "X," or some third force on both "X" and the economy.

These two descriptions of the St. Louis equations use the word exogenous in two different senses. In the first description exogenous means a variable subject to control by policymakers, while in the second, exogenous means a variable which does not respond to current endogenous forces. Clearly these two definitions do not correspond. The best known example of a conflict is the case of tax receipts. Tax receipts are exogenous in the policy sense of being subject to manipulation by policymakers, but they are clearly not exogenous in the statistical sense of not responding to current movements in the endogenous variable income.

The art of learning something from single-equation regressions of the St. Louis type consists in devising variables which can be manipulated by policymakers but which have been adjusted in such a way they are not terribly sensitive to current movements in the endogenous variables. If an explanatory variable does not meet the first requirement, it is not an effective policy instrument. If it does not meet the second requirement, then it is impossible to know what is influencing what, or how serious the problem of bias is in the equation. Failure to meet this second requirement has been a major criticism of regressions of GNP on the money supply.[4] Only if we can devise fiscal and monetary policy representations which get around this second problem will the single-equation approach be able to tell us something about the effects of macroeconomic policies.

Andersen and Jordan are clearly aware of this problem of devising variables that are exogenous under both definitions. That is presumably the reason for using high-employment Federal receipts and expenditures which are clearly much less affected by current endogenous movements in income than are actual receipts and expenditures. It also is the most powerful reason, it seems to us, for using the monetary base rather than the money supply. They have clearly moved in the right direction in both these respects. Our central doubt about the article, however, is whether they have gone far enough in purging their policy variables of the influence of current movements in economic activity. We feel that both the tax variable and the monetary base variable may still reflect the influence of current economic developments, and this leads us to try to represent monetary and fiscal policies by time series which are not quite the same as those of Andersen and Jordan.

The Reduced-Form Approach

Before examining the tax and monetary base variables, however, we would like to make two general remarks about the reduced-form or single-equation approach. One is that while there is much we can do in the way of adjusting policy measures for obvious and measurable endogenous influences, it is extremely difficult to devise variables which *fully* meet both definitions of exogenous. The problem is not simply that the variables policymakers influence are also influenced by current economic developments; part of the problem is that policymakers themselves are naturally influenced in their decisions by current developments. We may conjecture, however, that the endogenous responses of policymakers are much less mechanical or predictable than, say, the influence of income fluctuations on tax receipts, and are less likely to be serious sources of bias.

The second remark is that there are a host of other problems with the single-equation approach. Many exogenous variables (in the statistical sense) have to be left out while others are aggregated to crowd everything into one equation, in spite of likely dis-

[3]The statistical requirement is that exogenous variables be independent of the disturbance terms of the system. Failure to meet this requirement implies that an exogenous variable is not independent of the endogenous variables, and is what we mean by an exogenous variable "responding" to movements in endogenous variables.

[4]For example, see the criticism of the Friedman-Meiselman results by Ando and Modigliani in the *American Economic Review*, September 1965, pp. 711-13.

similarities in effects. There is no obvious reason why these problems should bias the coefficients in one direction and not in another for the included variables. If we were trying to devise the most useful single equation, however, there are other modifications we would try. We do not do so here in order to stay within the spirit of the Andersen-Jordan article.

Fiscal Variables

The tax variable is represented in the St. Louis article by high-employment receipts in current dollars. Adjusting actual receipts to a high-employment level is probably as good a job as we can do of eliminating the influence of fluctuations in real output, but this fails to eliminate the influence of inflation. That is, even full-employment tax receipts, when they are expressed in current dollars, go up faster during a period of rapidly rising prices than they do during a period of price stability. The tax variable, then, is still not exogenous in the statistical sense since it responds to current movements in the price level.

Fortunately, there is a simple way to eliminate, or largely eliminate, this source of bias. Instead of using full-employment receipts this period we can adjust last period's receipts to current prices by multiplying full-employment receipts by a ratio of this period's general price level to last period's general price level. When we subtract this inflated last-period figure from the current figure, we get the difference in full-employment receipts expressed in this period's prices. It seems to us that this is a clear improvement over the Andersen-Jordan variable.

The Monetary Base

Our next, and principal, concern is with the monetary base. The base may be expressed as the sum of three components: unborrowed reserves (including the adjustments for reserve requirement changes), borrowed reserves, and currency. For the base to be exogenous in a statistical sense, it must be assumed that the sum of these three components is largely independent of current disturbances in the endogenous variables. It appears to us that this assumption is open to debate. We would like to consider whether a variable with the properties we need could be more closely approximated by omitting borrowed reserves, or currency, or both.

Borrowed Reserves — Few would disagree with the proposition that, at least as the discount window has been administered for the last fifteen years, member bank borrowings have responded strongly to current movements in business loan demand and interest rates. The question of interest, however, is not whether borrowings are endogenous, since presumably that would be a matter of common agreement. Rather the question is whether there is a strong tendency for movements in borrowing to be offset by movements in some other component of the base. If there is a tendency for endogenous responses in borrowing to be offset by movements in other components of the base, then the total base contains offsetting endogenous influences and we should prefer the total base for the St. Louis regressions. If there is not such a tendency, then adjusting the base to remove borrowings produces a better monetary policy variable than the total base. Inclusion of borrowings in this latter case might lead to a statistical confusion between the effects of a high monetary base on the economy with the effects of a booming economy on borrowing and, hence, on the base.

The question is, then, whether unborrowed reserves or currency tend to fall when something happens in the general economy to make borrowings rise.[5] There are circumstances in which the answer probably is yes. For example, if the central bank is watching the rate of growth of bank credit or of the stock of money as an indicator of its effect on the economy, then an increase in borrowing which supports a rate of growth greater than the target rate might provoke a reduction in unborrowed reserves to put the rate of growth of credit or money back on target. It is easy, however, to think of circumstances in which a rise in borrowing might produce a reinforcing movement in unborrowed reserves if the level of borrowing itself is one of the statistics the central bank uses as an index of its effects, as it was during much of the 1950's. For then an increase in borrowing might well lead the central bank to expand unborrowed reserves in order to get borrowing back on target. Since it is not hard to think of unborrowed reserves responding in either direction to a change in borrowing during the sample period of the regressions, it seems to us better to represent monetary policy by a variable which excludes member bank borrowing.

Currency — There is a widespread agreement that the demand for currency responds to movements in income or some measure of transactions. We can again, as a matter of algebra, express the reduced-form equation for GNP in terms of either reserves

[5]Note that this is different from the question of what happens to the components of the base when the Federal Reserve exogenously changes its policy. Our interest here is in the response of the base to *endogenous* forces.

plus currency or in terms of reserves alone. The question once more is whether there is some strong tendency on the part of other components of the monetary base to offset the response of currency to current transactions or other endogenous influences. In the case of currency, there is an automatic mechanism making for an offset, since the usual procedure by which the public obtains more currency involves an initial decrease in vault cash or in bank reserves. The existence of this mechanism is one argument in favor of using the sum of reserves plus currency rather than reserves alone as a monetary policy variable.

There is more to the problem, however, than this automatic response. The reason is that over the sample period of the regressions, the central bank has tended to focus on banking and money market data in judging its current effect. It has not paid particular attention to movements in currency. If there is an increase in the rate of growth of currency — as there was 7 or 8 years ago — it is not permitted to cause a lower rate of growth of unborrowed reserves unless the central bank happens to want a lower rate of growth of reserves for other reasons. The net result is that an endogenous change in currency may well affect the monetary base, and that the base excluding currency may be a more suitable variable for the present study.

Because of these characteristics of member bank borrowing and currency, it seems to us well worth while to rerun the St. Louis equations with various alternative definitions of the monetary policy variable. We are not certain which of the definitions is preferable; therefore, we are not prepared to defend one set of regression results as superior to the others. We are, however, inclined to doubt the validity of conclusions about policy effects which are supported under one definition but contradicted under another.

Alternative Single-Equation Results

Table I contains the results of carrying out the above-mentioned modifications to the St. Louis equations. They are based upon the same sample period as that used in the St. Louis regressions, I/1952-II/1968, and data furnished by Andersen and Jordan were used to obtain the modified regressions in our equations. We used the same Almon technique for estimating the distributed lags, and we adhered to the Andersen-Jordan use of fourth degree polynomials in the estimation procedure. In short, we have remained quite close to the approach used by Andersen and Jordan, making only those changes which appear to us relevant to the question of statistical independence of the independent variables in the regressions.

The first equation presented in Table I is our replication of the St. Louis results, using the total monetary base and unadjusted high-employment expendi-

Table I

REGRESSIONS OF QUARTERLY CHANGES IN GNP (Current Dollars) ON CURRENT AND LAGGED CHANGES IN MONETARY AND FISCAL POLICY VARIABLES

(Sample period — I/1952 to II/1968)

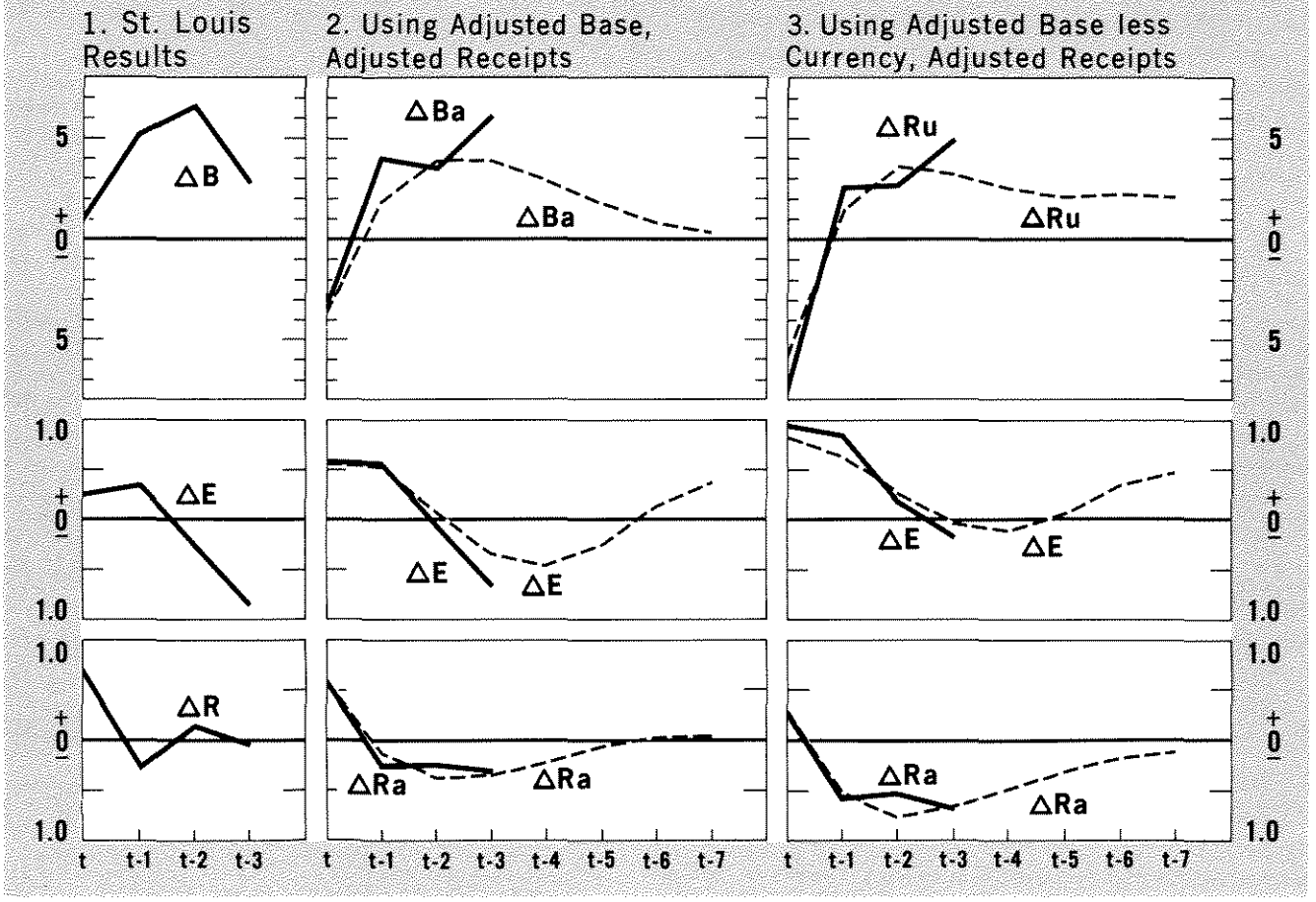
	REGRESSION EQUATIONS				
	1	2		3	
	St. Louis Results	Using adjusted base, adjusted high-employment receipts		Using adjusted base less currency, adjusted high-employment receipts	
Length of Lags (quarters)	4	4	8	4	8
Monetary Policy variable	ΔB	ΔBa	ΔBa	ΔRu	ΔRu
sum of coefficients	15.8	10.4	12.3	2.4	11.6
	(5.5)	(3.4)	(2.8)	(0.6)	(1.6)
Federal Expenditures variable	ΔE	ΔE	ΔE	ΔE	ΔE
sum of coefficients	—0.5	0.4	0.6	1.7	2.5
	(—0.8)	(0.7)	(0.6)	(3.7)	(4.1)
Federal Receipts variable	ΔR	ΔRa	ΔRa	ΔRa	ΔRa
sum of coefficients	0.5	—0.3	—0.5	—1.6	—2.8
	(0.6)	(—0.3)	(—0.4)	(—1.8)	(—2.6)
Constant	1.6	3.6	3.0	6.4	5.0
	(1.2)	(2.8)	(1.9)	(5.3)	(3.6)
R^2/SE	.51/4.4	.46/4.5	.53/4.2	.42/4.7	.56/4.1

Note: Figures given are regression coefficients; the "t" statistics appear below each coefficient, enclosed by parentheses.
ΔB = change in monetary base (currency plus total member bank reserves adjusted for reserve requirement changes)
ΔBa = change in adjusted base (B less changes in member bank borrowings)
ΔRu = change in unborrowed reserves (Ba less changes in currency, or unborrowed reserves adjusted for reserve requirement changes)
ΔE = change in high-employment expenditures, current dollars
ΔR = change in high-employment receipts, current dollars
ΔRa = change in high-employment receipts in current period prices (last period's receipts multiplied by ratio of current prices to last period's prices).

Figure I

LAG DISTRIBUTIONS:

REGRESSIONS OF CHANGES IN GNP ON CHANGES IN POLICY VARIABLES



tures and receipts. The very slight differences of these results from those of Andersen and Jordan are presumably due to program and computer differences. In Table I, we have presented the sums of the weighted coefficients of the distributed lags of the independent variables, and the t-ratios of the sums. The patterns of the weighted coefficients for each regression are presented graphically in the accompanying chart. Solid lines portray four-quarter distributions; dashed lines portray eight-quarter distributions.

The second equation indicates the results of making two of the changes indicated above. First, member bank borrowings were deducted from the total monetary base to obtain the adjusted base, Ba. Second, the high-employment receipts variable was adjusted for price changes using the implicit price deflator for GNP. Two sets of results for this variant are presented, one with four-quarter distributed lags on the independent variables, and one with eight-quarter lags. In both cases the results differ from the first equation in the following manner: (i) although the monetary policy variable remains the predominant influence in terms of t-ratios, the monetary multiplier decreases in size; and (ii) although the two fiscal policy variables remain insignificant statistically, the coefficients of the expenditures and receipts variables have the expected sign. These changes are due mostly to the adjustment of the monetary base rather than to the adjustment of high-employment receipts.

The third equation makes use of the monetary base adjusted to exclude currency holdings as well as borrowed reserves, leaving unborrowed reserves, Ru.[6] The expenditure and receipts variables are the same as in equation (2). Results are again shown for four- and eight-quarter lags.

[6]This variable is actually unborrowed reserves adjusted for reserves requirement changes during the period. For a discussion of the original monetary base and the reserve requirement adjustment see Leonall Andersen and Jerry Jordan, "The Monetary Base—Explanation and Analytical Use," in the August 1968 issue of this *Review*.

For the four-quarter lag distributions, the following changes are observed: (i) the monetary policy variable becomes insignificant statistically, and the size of the monetary multiplier decreases markedly compared with either equation (1) or (2); (ii) the expenditure multiplier rises to 1.7 with a t-ratio well above 2; and, (iii) the receipts variable has a multiplier of -1.6 with a t-ratio slightly below 2.

The shape of the lag distributions for the four-quarter distributions in equation (3) were such that it appeared desirable to extend the length of the lags. With eight-quarter lag distributions, the results are: (i) the monetary multiplier estimate is once again of the same order of magnitude as in equations (1) and (2), and the t-ratio rises to 1.6; (ii) the expenditure variable multiplier rises to 2.5 and retains a high t-ratio; and, (iii) the receipts multiplier rises to -2.8 with a t-ratio above 2.

By way of comparison, the multipliers for similar variables in the Federal Reserve/M.I.T. model are as follows:[7]

(i) For unborrowed reserves, the multiplier over eight quarters varies between 10 and 15, depending upon initial conditions.

(ii) Although not directly comparable with high-employment expenditures, the Federal purchases multiplier in the model is approximately 2.5. For average Federal expenditures (purchases and transfers) the multiplier is between 2 and 2.5. These values, again, are for eight quarters.

(iii) For Federal personal taxes, the multiplier is about -1.9. A multiplier including other taxes has not been calculated. It would probably also be less than 2.0 in absolute size for eight quarters for most other taxes, but might be higher for the investment tax credit.

[7]See Frank de Leeuw and Edward Gramlich, "The Channels of Monetary Policy," forthcoming in the Federal Reserve *Bulletin*.

The lag patterns portrayed in Figure I suggest longer lags for monetary and tax policies than for expenditures. In fact, in most of the equations contemporaneous changes in the monetary base and tax policies have "wrong" signs. These contemporaneous coefficients are puzzling, and we have no economic explanation of them.

The weights associated with the high-employment expenditure variable fall off rapidly for all of the four-quarter lag distributions. With eight-quarter distributions they fall and rise again. Andersen and Jordan indicate that the negative values at the tail of the four-quarter distributions are consistent with the hypothesis that rising Federal outlays "crowd out" private spending through their influence on interest rates. We note that the pattern of the weights when the lag distribution is extended to eight quarters resembles the early stages of a multiplier-accelerator cycle. It is, of course, impossible to demonstrate the superiority of either conclusion from results such as these.

Conclusion

We feel these results cast serious doubt on the Andersen-Jordan conclusions about fiscal policy. With alternative and highly plausible measures of Federal receipts and the monetary base, fiscal policy appears to exert a significant influence on GNP in the expected direction. Monetary policy also appears to exert a powerful influence.

More headway on these problems seems to us to depend on the development of measures of policy which we can be confident meet the statistical requirements of exogeneity. Possibly a detailed examination of Open Market Committee records would be helpful in constructing a better measure of monetary policy. Perhaps different measures for different policy-making epochs are necessary. Until we succeed in settling the statistical questions, extreme caution is advisable with respect to any economic interpretations.

The Reply to this Comment begins on next page.