
The Influence of Economic Activity on the Money Stock

This bank has, on previous occasions, presented arguments and evidence with respect to what has been called the "strong" monetarist position – that changes in the money stock are the best indicator of monetary influences on the economy, and that these influences have a significant impact on the course of economic activity over the business cycle. It is further contended that through its control of the monetary base, the Federal Reserve dominates movements in money.

One of the major counter-arguments presented against the strong monetarist position is the so-called "reverse-causation" argument. This states that actions of the public, as they respond to current economic conditions, so influence observed movements in the money stock that measurements of the relation between money and economic activity give no evidence with respect to the direction of causality. Therefore, it has been contended that the close statistical relation observed between money and economic activity, which is one of the major empirical bases supporting the strong monetarist position, is spurious.

The following three articles deal with various aspects of the reverse-causation argument. The first article, "Comments on the 'St. Louis Position'" by Emanuel Melichar, Economist, Board of Governors of the Federal Reserve System, states this argument, and maintains that the evidence presented in support of the strong monetarist position leads to erroneous conclusions. Melichar contends that once the money stock is made statistically free of reverse-causation influences stemming from the behavior of the public, this "neutralized" money stock gives an entirely different and more accurate interpretation of Federal Reserve actions than the actual money stock.

Michael Keran's "Reply" analyzes the statistical and theoretical underpinnings of Melichar's argument. He concludes, on the basis of Melichar's own criteria, that the actual money stock is superior to the neutralized money stock as an unbiased measure of Federal Reserve actions. In addition, because no rationale is given linking the neutralized money stock to the rest of the economy, he states it is not possible to interpret its significance.

The third article, "Additional Empirical Evidence on the Reverse-Causation Argument" by Leonall C. Andersen, investigates some other aspects of the reverse-causation argument. He presents empirical evidence that although the reverse-causation argument cannot be rejected, it is of relatively minor importance in explaining movements in the money stock. Moreover, to the extent that reverse-causation can be measured, it is due to Federal Reserve behavior rather than to behavior of the public. Andersen concludes that the statistical evidence relating changes in GNP to changes in the money stock cannot be viewed as spurious.

These three articles are available as Reprint No. 44.

ADDITIONAL EMPIRICAL EVIDENCE ON THE REVERSE-CAUSATION ARGUMENT*

by LEONALL C. ANDERSEN

A COMMON CRITICISM of studies which relate changes in gross national product (GNP) to changes in the money stock is the contention that the money stock is so influenced by economic activity that it is very difficult to identify and interpret the response of GNP to changes in money. Those who argue along this line assert that regression coefficients relating changes in GNP to changes in money, particularly in the current quarter, may be nothing more than a reflection of the response of money to changes in economic activity. In other words, the question arises as to whether the money stock can be treated as an exogenous variable.

This reverse-causation argument has frequently been made with respect to the recent study reported by Jerry L. Jordan and the author.¹ That study tested three hypotheses regarding the response of GNP to monetary and fiscal actions. These hypotheses were: "The response of economic activity to fiscal actions relative to that of monetary actions is: (I) greater, (II) more predictable, and (III) faster." In order to

*Preliminary versions of this article were presented at a Money and Banking Seminar, Federal Reserve Bank of Minneapolis, May 9, 1969, and at an Economic Seminar, Federal Reserve Bank of Philadelphia, May 23, 1969. The contents of this article are summarized in "Money and Economic Forecasting," a paper presented at the National Association of Business Economists' Seminar on "The Role of Money in Economic and Business Forecasting," New York City, June 5, 1969. The paper will appear in *Business Economics*, vol. IV, no. 3, Sterling Press, Inc., New York, N. Y. (September 1969). The author received many helpful comments, including constructive criticisms, from the participants of these seminars, particularly Richard Davis, Michael Evans, Edward Gramlich, and John Kalchbrenner. He also received valuable suggestions from Phillip Cagan, David Fand, Jerry Jordan, Thomas Mayer, Allan Meltzer, and Anna Schwartz. Elaine Goldstein was a valued assistant in the preparation of this study. The content of this article remains the sole responsibility of the author.

¹ Leonall C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," this *Review*, Federal Reserve Bank of St. Louis, November 1968, and available as Reprint No. 34.

test these hypotheses, test statements were presented in the form of single-equation, reduced-form relationships relating changes in GNP to changes in frequently used summary measures of monetary and fiscal actions. Results were reported for tests based on money (narrowly defined) and the monetary base as summary measures of monetary actions, and various high-employment budget concepts as summary measures of fiscal actions. The results of the tests led to the rejection of all three hypotheses.

The reduced-form equation found most useful was one with quarterly changes in nominal GNP as the dependent variable and quarterly changes in the money stock and in high-employment Government expenditures as exogenous variables (Table I).² The

Table I

REGRESSIONS OF CHANGES IN GNP ON CHANGES IN MONEY AND FEDERAL EXPENDITURES (1/1953 - 1/1969)

	ΔM	ΔE
t	1.51*	0.41
t-1	1.55*	0.50*
t-2	1.44*	-0.06
t-3	1.30*	-0.70*
Sum	5.79*	0.16
Constant	2.33*	
R ²	0.64	
S.E.	3.92	
D-W	1.77	

*Coefficients statistically significant at 5 per cent level.

Note: Coefficients estimated using Almon lag technique with a fourth degree polynomial; first differences in quarterly seasonally adjusted data are used. S.E. is the standard error of the estimate, and D-W is the Durbin-Watson statistic.

² High-employment receipts of the Government were found to have little explanatory power and were, therefore, excluded from the equation. High-employment expenditures include both outlays for goods and services and transfer payments.

Almon lag procedure was used, with the lag period for both exogenous variables consisting of observations for the current and three preceding quarters. This equation has been updated for this article to include the first quarter of 1953 through the first quarter of 1969.

As indicated in Table I, current period GNP responds positively to changes in the money stock in the current quarter and in each of the three preceding quarters. The total response to a given change in money is 5.8 times the change, which is found by summing the coefficients. On the other hand, current period GNP responds positively to changes in Government expenditures during the first two quarters and negatively during the last two, with a total response not significantly different from zero (sum of ΔE coefficients in Table I).

This article reports the results of testing the general proposition that the money stock can be treated as an exogenous variable in empirical research. The results indicate that the response of money to economic activity is very small, and that this response does not significantly affect the estimated response of changes in GNP to changes in money in the Andersen-Jordan equation. The reverse-causation argument, to the extent that it may produce serious bias in this equation, is not supported by the evidence presented in this article.

Summary of Channels of the Influence of Economic Activity on the Money Stock

The question of the influence of economic activity on the money stock can be examined best within the context of a specified money stock function. One such function has been developed and subjected to considerable analysis by Karl Brunner and Allan Meltzer.³ The narrowly defined money stock (M) is presented as the product of a money multiplier (m) and the monetary base (B):

$$M = mB$$

The money multiplier is defined as follows:

$$m = \frac{1 + k}{r(1+t+d) + k}$$

In the above, k is the ratio of currency held by the nonbank public to private demand deposits; t is the ratio of private time deposits to private demand deposits; d is the ratio of Government deposits at commercial banks to private demand deposits; and r is

the ratio of total commercial bank reserves to total bank deposits.⁴

Changes in the multiplier reflect, among other factors, actions of the public regarding their desired holdings of currency, demand deposits and time deposits, and actions of the commercial banks regarding desired holdings of excess reserves. These decisions are usually postulated to depend on GNP, market interest rates, and expectations about the future.

Changes in the monetary base summarize Federal Reserve actions involving open-market transactions, changes in the discount rate, and changes in reserve requirements.⁵ Changes in the base may also affect interest rates, thereby inducing changes in the money multiplier.

Critics of the Andersen-Jordan study have postulated that movements in GNP directly (and indirectly through interest rates) exert such an influence on the money stock that there is a positive association between changes in money and GNP,⁶ and therefore, they assert, the estimated influence of changes in money on GNP is overstated. These critics are particularly concerned about the estimated relationship between contemporaneous changes in GNP and the money stock.

Within the context of the Brunner-Meltzer money stock framework, if economic activity induces changes in the money stock, it must operate through induced changes in the multiplier and/or in the monetary base. This article, therefore, investigates the influence of economic activity on these two variables.

⁴ Member bank reserves plus vault cash of nonmember banks, adjusted for changes in reserve requirements of member banks.

⁵ For a discussion of the monetary base see: Leonall C. Andersen and Jerry L. Jordan, "The Monetary Base - Explanation and Analytical Use," this *Review*, August 1968.

⁶ With regard to these criticisms of the original Andersen-Jordan article, see Walter W. Heller's comments in his New York University debate with Milton Friedman, November 14, 1968. A transcript of this debate appears in *Monetary Versus Fiscal Policy*, W. W. Norton and Co., N. Y., 1969. Also see: Frank de Leeuw and John Kalchbrenner, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization - Comment," this *Review*, April 1969. Also, see: Lyle Gramley, "Guidelines for Monetary Policy - The Case Against Simple Rules," a paper delivered at the Financial Conference of the National Industrial Conference Board, New York, February 21, 1969.

For other recent discussions of the influence of economic activity on the money stock see: Emanuel Melichar, "Comments on the St. Louis Position," this *Review*, August 1969. Also, Patric Hendershott, *The Neutralized Money Stock: An Unbiased Measure of Federal Reserve Policy Actions*, Richard D. Irwin, Inc., Homewood, Illinois, 1968. For a discussion of both of these works, see: Michael Keran, "Reply" to Melichar's article, this *Review*, August 1969.

³ See Albert Burger, "An Analysis and Development of the Brunner-Meltzer Non-Linear Money Supply Hypothesis," Working Paper No. 7, Federal Reserve Bank of St. Louis, May 1969.

Test of Hypotheses

Four hypotheses are tested to examine the validity of the proposition that changes in the money stock are caused primarily by changes in total spending (GNP), and that the Andersen-Jordan relationship between changes in GNP and changes in money reflects mainly this reverse causation. Ordinary least-squares regressions are used in these tests, based on quarterly data for the period from the first quarter 1953 through the first quarter 1969.

Hypothesis I

The first hypothesis is that changes in GNP have a greater influence on changes in money than do changes in the monetary base. This is tested by regressing ΔM on current and three lagged values of both ΔGNP and ΔB .⁷ The response of money to changes in GNP is statistically significant for only the third lagged quarter, and in this case the relationship is negative (Table II), contrary to the positive relationship postulated by the critics. On the other hand, there is a statistically significant positive relationship between ΔM and ΔB in the first (contemporaneous) quarter.

Table II
REGRESSIONS OF CHANGES IN MONEY ON CHANGES IN GNP AND THE MONETARY BASE (1/1953 - 1/1969)

Lags	Regression Coefficients		Beta Coefficients	
	ΔGNP	ΔB	ΔGNP	ΔB
1	0.02443	1.83071*	0.15	0.66*
1-1	0.00418	0.65911	0.03	0.23
1-2	-0.00230	0.39597	-0.01	0.14
1-3	-0.03695*	-0.60500	-0.22*	-0.20
Sum	-0.01064	2.28079*	-0.05	0.83*
Constant	0.07275			
R ²	0.70			
S.E.	0.62			
D-W	1.72			

*Coefficients statistically significant at 5 per cent level.
Note: Coefficients estimated using ordinary least squares technique; S.E. is the standard error of the estimate, and D-W is the Durbin-Watson statistic.

The beta coefficients in Table II allow one to compare directly the contribution of each variable to variations in money in the test period.⁸ The beta coefficients for ΔB are much larger than those for ΔGNP for the contemporaneous and the first two lagged periods, and they are about equal for the last lagged period. Over the four quarters (measured

⁷ Read the symbol Δ as "change in."

⁸ For an explanation of beta coefficients see: Arthur S. Goldberger, *Econometric Theory*, John Wiley and Sons, Inc., New York, December 1966, pp. 197-200.

by the sum of the beta coefficients) the response of money to ΔB clearly dominates that to ΔGNP . Since these results are inconsistent with Hypothesis I, the hypothesis is not confirmed.

Hypothesis II

As mentioned earlier, one channel by which economic activity may influence the money stock is through the money multiplier. Also, in the money stock framework used in this article, ΔB influences market interest rates and thereby influences the money multiplier. Hypothesis II holds that the effect of ΔGNP on m dominates the effect of ΔB .

Table III
REGRESSIONS OF CHANGES IN THE MONEY MULTIPLIER ON CHANGES IN GNP AND THE MONETARY BASE (1/1953 - 1/1969)

Lags	Regression Coefficients		Beta Coefficients	
	ΔGNP	ΔB	ΔGNP	ΔB
1	0.00044	-0.01582*	0.22	-0.48*
1-1	0.00006	0.01378*	0.03	0.41*
1-2	0.00001	0.00786	0.01	0.23
1-3	-0.00075*	-0.00838	-0.37*	-0.23
Sum	-0.00024	-0.00256	-0.11	-0.08
Constant	0.00066			
R ²	0.36			
S.E.	0.01			
D-W	1.67			

*Coefficients statistically significant at 5 per cent level.
Note: Coefficients estimated using ordinary least squares technique; S.E. is the standard error of the estimate, and D-W is the Durbin-Watson statistic.

The regression results reported in Table III are similar to those reported in Table II. Changes in m have a statistically significant relationship to ΔGNP only in the third lagged quarter, and the relationship is negative, while the coefficients for ΔB are statistically significant in the first two quarters.

According to the beta coefficients, the response of m to ΔB dominates the response to ΔGNP in all quarters except the last one. The sum of the coefficients indicates that over four quarters neither variable exerts much influence on the money multiplier.⁹ Since the regression results are not consistent with Hypothesis II, it is not confirmed.

Hypothesis III

Another frequently postulated source of the influence of economic activity on the money stock oper-

⁹ This result does not imply that ΔGNP and ΔB have no influence on any of the components which enter into the multiplier. Instead, it implies that they have little net effect on the multiplier.

ates indirectly through its influence on changes in the monetary base. As a result, it is usually contended that a positive relationship between movements in GNP and in the base will be found in a regression analysis.

One frequently mentioned indirect channel is that changes in GNP cause changes in some of the sources of the monetary base, and that changes in these sources dominate the influence of Federal Reserve open-market purchases and sales of Government securities. As a result, it is contended that the monetary base, a chief determinant of the money stock, responds to economic activity. The most frequently mentioned sources responding to changes in GNP are borrowings from Federal Reserve Banks, the gold stock, and Federal Reserve float.¹⁰ Another indirect channel is that GNP influences changes in the monetary base through an implicit Federal Reserve reaction function involved in the formulation and implementation of its monetary policy. The proposition is usually advanced that by following a money market condition guide (market interest rates or free reserves), Federal Reserve actions are such as to cause pro-cyclical movements in the monetary base and money.¹¹

To test Hypothesis III — that the monetary base responds in a significant manner to Δ GNP — current quarter changes in the base were regressed on current quarter changes in GNP. Only contemporaneous changes were used because such changes are most frequently cited by those who invoke the reverse-causation argument.

The test period was divided into two sub-periods, based on two Federal Government administrations which held different views regarding economic stabilization policy (such a division is important for testing Hypothesis IV). The first subperiod, I/1954 to IV/1961, corresponds with the Eisenhower budget years, during which there was a conservative view regarding stabilization policy. The second subperiod, I/1962 to I/1969, corresponds with the Kennedy-Johnson budget years; this subperiod represents one of active discretionary stabilization policy, particularly the use of fiscal actions. Each subperiod was started two quarters after the start of a new administration's fiscal year, allowing for a period of adjustment in assuming full responsibility for economic stabilization.

¹⁰De Leeuw and Kalchbrenner. The argument presented in this paper was answered by Andersen and Jordan in their "Reply," this *Review*, April 1969.

¹¹Heller, pp. 83 and 84, and Gramley.

Table IV

REGRESSIONS OF CHANGES IN THE MONETARY BASE ON CHANGES IN GNP

	Δ Base is Dependent Variable		
	1954-61	1962-68	1954-68
	Δ GNP	Δ GNP	Δ GNP
t	0.00772	0.02428*	0.03563*
Constant	0.14274	0.46117	0.14287
R ²	0.04	0.19	0.35
S.E.	0.21	0.25	0.31
D-W	1.42	1.48	1.18

*Coefficients statistically significant at 5 per cent level.

Note: Coefficients estimated using ordinary least squares technique; S.E. is the standard error of the estimate, and D-W is the Durbin-Watson statistic.

The Chow test indicates that there was a significant shift in the relationship between contemporaneous changes in GNP and the monetary base between these two subperiods; the F-statistic for the Chow test was 48.9, which is statistically significant beyond the 1 per cent level.

The regression results (Table IV) indicate a positive but varying relationship between contemporaneous changes in GNP and in the monetary base. A \$1 billion change in GNP is associated with an \$8 million change in the monetary base in the first subperiod, and with a \$24 million change in the second. The equation explains only 4 per cent of the variance in changes in the base in the first subperiod and 19 per cent in the second, leaving most of the variance explained by other factors.

The regression results show a contemporaneous relationship between Δ B and Δ GNP, but the direction of causation is not clear. However, the results are consistent with Hypothesis III that the monetary base responds to changes in GNP, implying that money may also respond in a similar manner in contemporaneous quarters.¹²

Hypothesis IV

Given the results of testing Hypothesis III, an extreme version of the critics' point under examination would imply that there should be a significant change between these two subperiods in the response of changes in GNP to changes in money. Hypothesis IV is that the response of GNP to changes in money would be greater in the second subperiod when there

¹²Michael Keran and Christopher Babb, "An Explanation of Federal Reserve Actions (1933-68)" this *Review*, July 1969, present empirical evidence that the channel of this response of the monetary base is the Federal Reserve's reaction function, and not movements in some of the sources of the base which are related to economic activity.

Table V

**REGRESSIONS OF CHANGES IN GNP
ON CHANGES IN MONEY AND
FEDERAL EXPENDITURES**

	ΔGNP is Dependent Variable					
	1954-61		1962-68		1954-68	
	ΔM	ΔE	ΔM	ΔE	ΔM	ΔE
t	2.21	0.45	2.08*	0.23	1.94*	0.26
t-1	0.83	0.45	-0.26	0.28	0.26	0.43
t-2	1.11	0.67	3.08*	-0.17	2.65*	0.11
t-3	2.20	-1.12*	0.67	-0.43	0.83	-0.69*
Sum	6.35*	0.45	5.57*	-0.09	5.68*	0.11
Constant	2.19		3.87		2.86	
R ²	0.48		0.78		0.70	
S.E.	4.69		2.70		3.72	
D-W	1.76		2.45		1.95	

*Coefficients statistically significant at 5 per cent level.

Note: Coefficients estimated using ordinary least squares technique; S.E. is the standard error of the estimate, and D-W is the Durbin-Watson statistic.

was a greater response of the base to changes in GNP than in the first.

Regressions of ΔGNP on current and lagged changes in money and Government expenditures for these two subperiods do not confirm this hypothesis (Table V). The regression coefficients for current changes in money are almost identical in both periods, as are the sums of the coefficients. Moreover, the Chow test rejects the proposition that there was a shift in the relationship; the F-statistic equals .45 and is not statistically significant at the 5 per cent level. Although there is support for the proposition that the monetary base responds to changes in GNP, variations in the strength of this relationship are not accompanied by corresponding changes in the regression coefficients relating changes in GNP to changes in the money stock.

Conclusion

The evidence presented in this article supports the view that changes in the money stock are dominated by changes in the monetary base and are therefore largely under the direct control of the Federal Reserve. As a consequence, money may be treated as an exogenous variable. Although evidence was presented consistent with the hypothesis that there is some response of the monetary base (the major determinant of the money stock) to economic activity, this possible response does not appear to influence in any appreciable manner regression coefficients relating changes in GNP to changes in money and Government expenditures.

There is recent collaborating evidence supporting the view that money is little influenced by economic activity. Richard G. Davis has recently conducted a thorough study of the Andersen-Jordan equation.¹³ With regard to the reverse influence of economic activity on money, he concludes:

The specific variable GNP, however, seems to contribute rather little extra to explaining the variance in monetary changes beyond what is explained by the policy variables. Hence, only a relatively modest part of the gross relationship between money and GNP exhibited in the St. Louis equation may reflect a feedback effect from GNP to money.¹⁴

David I. Fand has found that allowing for feed-backs from the real sector to the money stock does not materially affect the response of the money stock to Federal Reserve controlled variables. He examined many money supply models which have been subjected to statistical measurement and concludes that:

. . . the available evidence, meager though it may be, does not point to any superiority of M.S. IV [fully specified feed-backs] over M.S. I [no feed-backs], and does not appear to favor a real view over a monetary view. Those who take the view that money is passive, responding to the real economy, have to recognize that this is an assumption rather than a proposition derived from empirical evidence.¹⁵

This article has presented evidence which leads to a rejection of the extreme version of the reverse-causation argument — that the money stock responds to changes in economic activity to such an extent as to cast considerable doubt on the validity of the St. Louis equation. It is now incumbent upon those who would conclude, as did one critic, that “. . . they [Andersen-Jordan] should have concluded that something was rather badly wrong about their method,”¹⁶ to produce empirical evidence supporting their contention of the overwhelming importance of the reverse-causation assumption in monetary research.

¹³Richard G. Davis, “How Much Does Money Matter?”, *Monthly Review*, Federal Reserve Bank of New York, June 1969.

¹⁴*Ibid.*, p. 129.

¹⁵David I. Fand, “Some Implications of Money Supply Analysis,” *American Economic Review*, May 1967, p. 392.

¹⁶Gramley, p. 7.

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