AN ECONOMETRIC INVESTIGATION OF THE RELATIVE EFFECTIVENESS OF MONETARY AND FISCAL POLICY

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CHAPTER I

INTRODUCTION

Statement of the Problem

In recent years there has been a growing interest in the relative importance of monetary and real variables in determining economic activity. Monetarists believe that changes in the money supply are the main sources of change in gross national product, GNP. In contrast, Keynesians argue that changes in real variables, such as investment and government expenditures, have a predominant impact on the GNP. In assessing empirically the relative importance of monetary and real variables, the two most important studies are those by Friedman and Meiselman (31) and by Andersen and Jordan (2). In this endeavor, Friedman and Meiselman have studied the relative stability of monetary velocity and the investment multiplier in the United States for the period of 1897-1958 and sub-periods of that time; in addition, Andersen and Jordan have examined the relative importance of monetary and fiscal variables in determining the change in economic activity. The results of these two studies lead Friedman and Meiselman and lead Andersen and Jordan to conclude that monetary variables are the predominant source of change in income and economic activity. However, in these papers and the resulting criticisms, the following econometric questions have been raised, but not fully resolved:

a. Are the independent variables in single equation models of Friedman and Meiselman and of Andersen and Jordan and their critics exogenous?

b. Are the changes in full employment surplus and expenditures that Andersen and Jordan use good proxies for measuring the fiscal variable?

c. How different would Andersen and Jordan's results be if different lag structures are used, rather than the Almon distributed lag?[1]

Since these questions and problems have not been fully resolved, it is worthwhile to re-examine them. Thus, the purpose of this paper is to study these questions in light of recently developed econometric techniques.

For finding the proper measure of independent variables in their single equation models, Friedman and Meiselman (31) correlate alternatively defined measures of the independent variables, which are money supply and autonomous expenditures, with consumption and income. In their study the question of whether, for example, K+A or A alone is a preferable definition for autonomous expenditures is answered by considering the following two conditions (pp. 182-183):

1. $r_{J(K+A)} > (r_{JK} \text{ and } r_{JA})$

2. $r_{A(K+J)} > (r_{AK} \text{ and } r_{AJ})$

where K and J are consumption on durable and non-durable goods, respectively; A is the assumed autonomous expenditures other than K; and $r_{J(K+A)}$ is the correlation coefficient between J and K+A and similarly for other subscripts. In this endeavor, the Friedman and

[1]Andersen and Jordan have applied the Almon distributed lag with the fourth degree polynomial to their reduced form equation.

Meiselman (31, p. 183) approach for determining whether K is autonomous, yields the following criteria:

Condition (1)	Condition (2)	Conclusion
satisfied	not satisfied	K is autonomous
not satisfied	satisfied	K is induced
satisfied	satisfied	ambiguous
not satisfied	not satisfied	ambiguous

With the exception of the Great Depression years, Friedman and Meiselman (31) find, for the period of 1897-1958, a higher correlation coefficient between consumption and money supply than between consumption and autonomous expenditures. More specifically, they write: "The stock of money is unquestionably far more critical in interpreting movements in income than is the autonomous expenditures" (p. 188).

The correlation coefficient technique is also adopted by Friedman and Meiselman's critics Hester (44), Ando and Modigliani (6) and by Deprano and Mayer (19) in defining the Keynesian macro-theory. They make several important changes in Friedman and Meiselman's technique, such as using different time periods and different definitions of autonomous expenditures and money supply that lead to entirely different conclusions. However, the correlation coefficient technique used by Friedman and Meiselman (31) and by their critics in determining an exogenous and appropriate measure of money supply and autonomous expenditures in their single equation models is not a sufficient criterion. Friedman and Meiselman (31) are aware of the statistical problem associated with the exogeneity of the variables used in their single equation model. Their dissatisfaction is expressed thusly:

> We are by no means satisfied that we have used the appropriate criteria in drawing the lines [see footnote 2]. Neither are we satisfied with the precise lines we have drawn . . . Much further work remains to be done on this fundamental problem, in particular in determining statistical tests for making the best choice (p. 181).

The second controversial study is that made by Andersen and Jordan (2). They examine the relative importance of monetary and fiscal variables in determining the change in GNP and conclude that the response of changes in GNP to monetary variables, relative to fiscal variables is greater, more predictable, and faster (p. 24). Their assessment, similar to what Friedman and Meiselman (31) and their critics have done, is based on the regression analysis. They estimate the regression of the fiscal variables by using the Almon distributed lag technique for the period of data from the first quarter of 1952 through the second quarter of 1968. In their study the change in weighted full employment expenditures and taxes and the change in monetary base and money supply are used as the measure of fiscal and monetary variables, respectively. The results of their study indicate that the monetary variables have larger beta coefficients and more significant regression coefficients than the fiscal variables. These results lead them to conclude that monetary variables are the primary source of change in economic activity.

The Andersen and Jordan (2) study, while showing a new attempt in determining the primary source of changes in economic activity, has raised some issues as well. They are the following:

1. Unfortunately in the 1950's and 1960's, similar to Friedman and Meiselman, neither Andersen and Jordan nor most of their critics,

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[2] It means that using the correlation coefficient technique in finding the proper measure of money supply and autonomous expenditures is not quite satisfactory to Friedman and Meiselman.

have had a better method than correlation coefficient analysis in assessing the exogeneity of their fiscal and monetary variables. In other words, little attention is given to applying a statistical test for selecting a better definition of the exogenous variables. But today the two newly developed econometric techniques by Granger (40) and Sims (67) enable statistical tests of this presently unexplored problem.

2. Andersen and Jordan's (2) research is criticized by Blinder and Solow (11) for using what Blinder and Solow consider to be an incorrect measure of fiscal variables; that is, Blinder and Solow believe that the change in full employment surplus, as used by Andersen and Jordan, is not a good proxy for measuring fiscal variables. Instead, they suggest using the change in weighted standardized surplus as a measure of fiscal variables. Blinder and Solow (11, p. 69) argue that using the incorrect measure of fiscal variable biases the coefficient of that variable toward zero. Thus, using the change in weighted standardized surplus might provide a decisive answer to this criticism.

3. Andersen and Jordan (2), in contrast to Friedman and Meiselman (31), obtain a more powerful estimate of lagged response by using the Almon polynomial interpolation technique.[3] But their study stimulates the question of whether the application of other types of distributed lag techniques to Andersen and Jordan's reduced form equation can result in the same conclusions as those for the Almon distributed lag which are obtained by Andersen and Jordan (2).

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[3]Friedman and Meiselman have used the variables both in levels and in first difference.

Objectives

This study is an attempt to clarify the controversial issues discussed earlier. The explicit purposes of this study are:

1. To determine the exogenous components of autonomous expenditures and monetary variables in Friedman and Meiselman's (31) study.

2. To find the exogenous components of the monetary variable in Andersen and Jordan's (2) reduced form equation and to determine a better measure of the monetary variable for their single equation model.

3. To use the proper measure of fiscal variable in Andersen and Jordan's (2) study; that is, to use the weighted standardized deficit as a measure of fiscal variable, as suggested by Blinder and Solow (11).

4. To test the sensitivity of Andersen and Jordan's (2) results to four alternative distributed lags (Almon, Koyck, Pascal, and rational distributed lags).

Organization of the Study and Summary of the Results

Chapter II represents a review of literature. It provides a survey of arguments and criticisms related to Friedman and Meiselman's (31) and to Andersen and Jordan's (2) studies and presents the major issues and differences of these arguments. It also gives the reader a general understanding of the existing problems. Chapter III presents the methodology used in this study. Granger's and Sims' tests of causality and their applications are thoroughly defined, and the reader is provided with a general knowledge of the test statistics to determine the exogeneity of different components of money and autonomous expenditures. This chapter also discusses the construction of different distributed lag techniques and their applicabilities to the Andersen and Jordan reduced form equation. Additionally, the construction of the change in weighted standardized deficit for eliminating the bias which resulted from using the change in weighted full employment surplus as a measure of fiscal variable is given. Chapter IV contains summary of findings and results. In this chapter, the results indicate that the outcome of the two tests of causality, with few exceptions, neither support Friedman and Meiselman's (31) and Andersen and Jordan's (2) definitions of exogenous real and monetary variables nor the other definitions cited by their critics. Instead, the results of this study suggest two new definitions of autonomous expenditures and two exogenous monetary variables for Friedman and Meiselman's study. Moreover, the results confirm the exogeneity of the weighted standardized deficit as the measure of fiscal variable in the Andersen and Jordan's reduced form equation, as Blinder and Solow (11) suggest. Results in Chapter IV also indicate that fiscal variable performs much better when the rational distributed lag is applied to the Andersen and Jordan's reduced form equation. In other words, results are quite sensitive to the forms of the distributed lags. Finally, Chapter V presents the evaluation of the previous works along with some conclusions and remarks. The overall results of this study suggest that the relative importance of real and monetary variables is indeterminate. It depends upon the definition of monetary variable, the use of quarterly or annual data, and the time period. Moreover, this chapter concludes that although there is a significant role for fiscal variable in determining the change in GNP, the overall conclusion of the Andersen and Jordan study that monetary variables have more impact on GNP is left untouched.

CHAPTER II

SURVEY OF PREVIOUS STUDIES

Friedman and Meiselman and Their Critics

Friedman and Meiselman (31) have tested the stability of the velocity of money and the investment multiplier by comparing the correlation between "induced expenditures" and money supply to the correlation between "induced expenditures" and autonomous expenditures using annual and quarterly data between 1897-1958 and various sub-periods of that time. They have predicted consumption in the United States from two equations. One equation uses the money supply and the other equation uses autonomous expenditures as the independent variable.

According to Friedman and Meiselman (31), the two alternative hypotheses, the income-expenditure theory and the Quantity Theory of Money, can be embodied in the following two respective equations:

$$C = a_1 + kA \tag{1}$$

$$C = a_2 + vM, \tag{2}$$

where A and M are autonomous expenditures and money supply, respectively; a's are constant terms; and C is private consumption expenditures. Equation (1) and (2) are derived from:

$$Y = b_1 + v'M,$$

$$Y = b_2 + k'A,$$

and the identity equation

$$Y \equiv C + A$$

where Y is total income. They have selected the independent variables by using the correlation coefficient technique. For example, Friedman and Meiselman (31) assess the exogeneity of D, the consumption on durable goods, by examining whether $r_{N(D+A)} > (R_{ND}$ and $r_{NA})$ and $r_{A(D+N)} > (r_{AD}$ and $r_{AN})$ are satisfied. The dependent variable, in one set of tests, is N (consumer non-durable) rather than C (total consumer expenditures) to avoid correlating C with D (one of its components). Friedman and Meiselman (31) state that:

> If D is autonomous, then the correlation of N with A+D (where A is assumed autonomous other than D) should be higher than the correlation of N with A or N with D, respectively. On the other hand, D is induced, then the correlation of N with D or A alone might be higher than the correlation of N with A+D (p. 248).

In this endeavor, Friedman and Meiselman (31) define autonomous expenditures and stock of money as follows:

M_2: currency in public circulation plus adjusted demand deposits in commercial banks.

A: (net private domestic investment plus the government deficit on income and product account plus the net foreign balance) = (federal and state government expenditures - taxes of federal and state government + net exports of goods and services + producer's durable equipment + nonresidential structure + residential structure + change in inventories - depreciation allowances + net foreign investment) (p. 184).[1]

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[1]Net foreign investment is equal to net exports if the transfer payment to foreigners from government and persons is included in imports, but it is intentionally excluded in order to apply tests of exogeneity to them.

The simple and the partial correlation coefficients resulting from the estimation of equations (1), (2), and the equation $C = \alpha + \beta M + \gamma A$ (shown in Table I) appear to favor the quantity theory overwhelmingly. They find that, with the exception of the Great Depression years, money has higher simple and partial correlation coefficients than autonomous expenditures with consumption. Consequently, it leads them to conclude that the change in money explains the change in consumption and the change in economic activity better than autonomous expenditures.

TABLE I

PARTIAL AND SIMPLE CORRELATION COEFFICIENTS
(FRIEDMAN AND MEISELMAN'S STUDY)

Period	r_{CM}	r_{CA}	$r_{CA.M}$	$r_{CM.A}$
Annual Figures				
1897-1958	.985	.956	-.222	.967
1908-1921	.995	.672	.400	.993
1929-1939	.912	.937	.688	.529
1948-1957	.990	.747	.361	.980
1929-1958	.974	.705	-.424	.957
Quarterly Figures				
1945_{III}-1958_{IV}	.985	.511	.044	.973
1946_{I}-1958_{IV}	——	——	.286	.973

Source: Friedman and Meiselman (31, pp. 190; 225-226).

Their conclusions are strongly criticized by a number of economists including Ando and Modigliani (6), Deprano and Mayer (19), and Hester (44). In defending the Keynesian income expenditure model, they have modified Friedman and Meiselman's technique and have come out with entirely different conclusions.

Ando and Modigliani

Ando and Modigliani's (6) contention that the Friedman and Meiselman (31) results are irrelevant is based upon four conclusions.

Misspecifications of the Consumption Function. Ando and Modigliani (6) disapprove of the definition of consumption function, C = a + kA, given by Friedman and Meiselman (31). They start with the conventional elementary form of the consumption function as

$$C = c_0 + c_1 Y_d + \varepsilon \qquad (3)$$

where c_0 and c_1 are constant, ε is a random-error term, and Y_d is disposable infomr. They substitute (3) into the identity equation

$$Y \equiv C + S$$

and solve it for C and then obtain their form of consumption function

$$C = \frac{c_0}{1-c_1} + \frac{c_1}{1-c_1} S + \frac{1}{1-c_1} \varepsilon \qquad (4)$$

where S is the personal saving. Therefore, in contrast to the consumption function defined by Friedman and Meiselman (31), Ando and Modigliani (6) believe that the independent variable in (4) is not A but S. They argue that it differs from A "by corporate retained earning adjusted for inventory valuation (r), the statistical discrepancy (H), excess of wage accruals over disbursement (W), and government foreign-transfer payment (T_f)" (6, p. 696). Consequently, Ando and Modigliani (6, p. 696) state that using Y, income, instead of Y_d, disposable income, involves "grievous misspecification" of the consumption function.

Friedman and Meiselman (33, p. 774) apparently do not accept this criticism and respond, "we were led to use Y by the empirical evidence and theoretical criterion we used in choosing a concept of autonomous expenditures." They explicitly assert:

> Ando and Modigliani acknowledge that recent work suggests including in the relevant income total one component of the difference between Y and Y_d (R = corporate savings) and later in their text they dismissed the other components of the difference (H + W + T_f) as 'minor reconciliation items'. We share the view described in their paper but not accepted by them, that recent work by them, by one of us, and by others recommends the use of Y rather than y_d (p. 774).

Treatment of War Years. The period of the World War II is Ando and Modigliani's (6) second major consideration in opposing Friedman and Meiselman's (31) results. They believe the c_0 and c_1 of the equation (4) cannot be stable over a period including the war years, especially when one recalls that C is defined to include purchases of consumers' durables. Ando and Modigliani (6, p. 697) state that "during this period consumers may have been persuaded to consume abnormally small proportions of their consumption habits in response to rationing and to inavailability of some goods." Therefore, they argue that the period of 1942-1946 should be deleted from the whole study.

Friedman and Meiselman (33), in their response to this criticism by Ando and Modigliani (6), argue that Ando and Modigliani's study has no relevance to their study, since a different data period is used.[2]

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[2]Ando and Modigliani (6) treat the period from 1929-1958 as one whole.

They (33) state that in choosing the periods of 1897-1958, instead of 1929-1958 as used by Ando and Modigliani (6), three considerations are taken into account:

> First, since the question at issue is mainly the short-term stability of the relations being compared, it seems desirable to make the comparisons for relatively short periods. Second, since the relations may differ at different phases of the cycle, it seems desirable that any one comparison should cover one or more complete cycles . . . Third, since most of the available data are annual, a single business cycle generally provides too small a number of observations to yield statistically meaningful results (p. 760).

Inclusion of Induced Components in the Autonomous Expenditures and the Resulting Least-Square Bias. Ando and Modigliani (6) argue that whether the independent variable of equation (4) is S, as called for by the standard consumption function, or the variable A, arbitrarily picked by Friedman and Meiselman (31), one still cannot get a best linear unbiased estimate of the parameters by the method of least squares. The reason is that both S and A are correlated with the residual error of the consumption function (3). After setting aside from the minor reconciliation items ($H + W + T_f$), personal saving S is expressed by Ando and Modigliani (6) as

S = Private Domestic Investment + Government Expenditure + Exports - (Net Taxes + Imports + Corporate Saving).

They believe that the items inside the parentheses cannot be regarded as autonomous variables. The expression in parentheses, which is positively correlated with the error term, appears in S with a negative sign. Consequently, Ando and Modigliani (6) argue that the direct regression of C on S or C on A will yield a downward biased estimate of the coefficients. Therefore, they present a modified S as

$$S \equiv Y_d - C \equiv (N - C) + (Y_d - N) \equiv Z + X$$

where N is net national product. When the autonomous part of Z and X (Z^a and X^a) are used, the equation (1) should be written as

$$C = \alpha_1 + \alpha_2(Z^a + X^a) + \varepsilon \qquad (5)$$

where in equation (5),

Z^a = net investment in plant and equipment and residential houses + total government purchases of goods and services + exports, and

X^a = property tax portion of indirect business taxes + net interest paid by government + (government transfer payment - unemployment insurance benefit) + subsidies less current surplus of government enterprises - H - W.

Ando and Modigliani (6) estimate equation (5) rather than equation (1), which is estimated by Friedman and Meiselman (31), for testing the stability of the Keynesian multiplier against the Quantity Theory of Money. Their findings, for the period of 1929-1958, indicate the significant regression coefficients of 1.60, 1.34, and 3.84 for (Z^a + X^a), Z^a, and X^a, respectively (6, p. 704). Therefore, they argue that the relatively small and insignificant regression coefficients for autonomous expenditure in Friedman and Meiselman's (31) study are due to the inclusion of the second World War years, using the induced components in their independent variable, and the oversimplification of the consumption function.

The response of Friedman and Meiselman (33) to this criticism basically is again limited to the different time period that Ando and Modigliani use in their paper and the resulting irrelevance of Ando and Modigliani's study to Friedman and Meiselman's original paper. Additionally, Friedman and Meiselman (33) argue that the dependent variables in the Ando and Modigliani (6) study are not the same as in their paper.[3] Therefore, both standard errors and correlation coefficients are likely not comparable. Moreover, they state that one cannot compare the statistical results obtained from different data periods.[4] They re-estimate the Ando and Modigliani equation and their model for the pre- and post-World War II period. Their results indicate a higher correlation coefficient for A than for $(Z^a + X^a)$ except for the post-World War II period (33, p. 759). Therefore, Friedman and Meiselman (33) believe that substituting $(Z^a + X^a)$ for A, first, lessens the correlation coefficients of the income expenditure for the pre-World War II years. Second, substituting $(Z^a + X^a)$ for A raises the correlation coefficients for the autonomous expenditures for the post-World War II years but still leaves them lower then the Quantity Theory correlations.

Inclusion of Induced Components in the Monetary Variable and Resulting Least-Square Bias. Ando and Modigliani (6) consider two possible sources of bias in correlation between C and the stock of money as reported by Friedman and Meiselman (31). The first source of bias, they believe, comes from the definition of demand for money and the assumption of the existing equilibrium in the money market.[5] Ando and Modigliani (6, p. 708) use the demand function for money that Friedman and Meiselman define as

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[3]Ando and Modigliani (6) use $C_f = C + Z$ and $C = Z + N$ as induced expenditures in their study. Z = net private domestic investment (K) + government expenditures (G) + exports (E) - imports; whereas, Friedman and Meiselman (31) use private consumption expenditures as induced expenditures.

[4]Friedman and Meiselman (31) use the entire period of 1897-1958 while Ando and Modigliani (6) study the period of 1929-1958.

[5]Equilibrium in the money market implies $M^d = M^s$, where M^d and M^s are the demand for and supply of money, respectively.

$$\frac{M^d}{P\pi_p} = \gamma\left(\frac{N_p}{P\pi_p}\right)^{\delta} + \eta$$

and the demand for money implicit in Friedman and Meiselman's tests, namely

$$M^d = g_1 N_t + g_2 + \varepsilon$$

to derive the following equation:

$$N_t = \frac{1}{\gamma\beta(1-\rho)} M^S - \frac{\rho}{(1-\rho)} N_{p,t-1} - \frac{\eta}{\gamma\beta(1-\rho)} \tag{6}$$

where g_1, g_2, δ, γ, are constant; η and ε are random-error terms; β is an adjustment factor for the time trend in N; N is net national product; ρ is about 0.7; P is population; π_p is permanent price level; and N_p is measured permanent net national product. They state that in equation (6) M^S and $N_{p,t-1}$ are both predetermined variables. Therefore, Ando and Modigliani (6) strongly believe that Friedman and Meiselman should have added variable $N_{p,t-1}$ to their test equation. Consequently, Friedman and Meiselman have misspecified their test equation and, thereby, are faced with the first source of least square bias. The second source of bias in Friedman and Meiselman tests comes directly from the definition of money supply. Ando and Modigliani (6) argue that, under the institutional arrangements that prevailed during the period covered by the tests, M is partly induced and therefore, M is positively correlated with the error term. Instead, they suggest that M be replaced with M* where, M* = maximum currency plus demand deposits that can be created, given the supply of reserves by the federal reserve minus borrowed reserves.[6]

Their results suggest a smaller correlation coefficient for M* than for M when $N_{p,t-1}$ is included; yet a significant regression coefficient exists. After these changes in the definition of money supply and autonomous expenditures, Ando and Modigliani's (6, pp. 704; 712) results turn out to be strongly supportive of the Keynesian income-expenditure theory while the role of money is also significant in determining economic activity.

Friedman and Meiselman (33) apparently accept the theoretical idea that some part of the movement in M may itself be induced. But they believe that during pre-World War II replacing M with M* is not desirable unless the reserve requirements for which M* is calculated are the banks' desired reserve requirements, not legal reserve requirements. They foster this belief because, in the definition of M*, reserve requirements are interpreted as legal reserve requirements but currency holding habits as actual habits. Therefore, Friedman and Meiselman (33) believe the M* on this basis is limited by currency holding habits and is completely unaffected by banking behavior.

Deprano and Mayer

The second critics of Friedman and Meiselman's study, Deprano and Mayer (19), oppose the definition of the autonomous expenditure given by Friedman and Meiselman (31) as an exogenous variable. They believe

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[6]Ando and Modigliani (6) compute $M^* = \frac{L - B}{L - E} M$ where L = currency in circulation + member bank deposits - reserves against time deposits - reserves against U.S. government deposits; B = member bank borrowings from the Federal Reserve; E = member bank excess reserve; and M = currency + demand deposits adjusted.

that government deficit on income and product account, gross private domestic investment, and the net foreign balance are partially endogenous. They argue that an increase in consumption has a positive effect on inventory investment in the same year.[7] The reason for this argument is that the "lead time" for inventories is generally short. Also, an increase in consumption can lead to unplanned disinvestment in inventories. Deprano and Mayer (19) classify tax receipts as an endogenous variable, because an increase in income raises the tax receipts. In addition, they exclude imports from their definition of autonomous expenditures. They believe that increase in consumption are accompanied by increases in imports, which are a negative component in net foreign investment, thereby resulting in downward bias in the correlation coefficient. Consequently, they define the autonomous expenditure L = I + G + E - Im, where I is net domestic investment, G is government expenditure, E is exports, and Im is imports. Deprano and Mayer (19) correlate money and different concepts of autonomous expenditures with consumption for the whole period of 1929-1963 and some sub-periods of that time. Their results surprisingly indicate that in all periods gross private domestic investment, gross private domestic investment plus exports, and money do extremely well. Comparing simple and multiple correlation coefficients leads them to conclude that money and autonomous expenditures together explain consumption much better than money or autonomous expenditures alone.

Friedman and Meiselman's (33) reply to Deprano and Mayer is similar to their reply to Ando and Modigliani. They believe that, in using a

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[7]Inventory investment is a part of the fixed private domestic investment in Deprano and Mayer's study.

different data period, Deprano and Mayer's paper is not relevant to their original paper. Moreover, Friedman and Meiselman (33) argue that for each definition of autonomous expenditure one should use different induced components. For example, if Deprano and Mayer's concept of autonomous expenditure is gross domestic investment and exports, their induced components necessarily should be

U** = U* + state and local government expenditures on goods and services - capital consumption allowances + federal government expenditures on income and product account.

where U* equals consumption plus net inventory minus imports minus transfer payments (33, pp. 776-777). But, Deprano and Mayer (19) instead use C as induced consumption. Therefore, their results cannot be compared with the Friedman and Meiselman's original paper.

Hester

Hester (44), in defending the Keynesian income-expenditure theory, stresses that the government deficit and net foreign balance included in Friedman and Meiselman's definition of autonomous expenditures are not likely to be exogenous variables. For example, he believes that taxes are often represented as a function of net national product, N, and therefore should be eliminated from the autonomous expenditures, A. Consequently, he defines four alternative definitions of autonomous expenditures

$L = I + G + E - Im,$

$L' = L + Im + D,$

$L'' = L' - Im,$ and

$L''' = L' - F,$

where I is net domestic investment, G is government expenditures, E is exports, Im is imports, D is depreciation, and F is the change in inventories (44, pp. 366-367). Hester (44) correlates money and these autonomous expenditures with consumption, C, for the whole period of 1929-1958 and some sub-periods of that time. With the exception of the Great Depression years, his findings indicate a higher correlation coefficient between C and the L's than between C and A, but still lower than the correlation coefficient between C and M (p. 367). The results of his study lead him to emphasize that using gross rather than net investment and using exports rather than trade deficit improves the estimated consumption function.

Friedman and Meiselman (32) believe that Hester's study is not relevant to their paper because he uses different periods of data. Moreover, Friedman and Meiselman (32) argue that the value of taxes is not required for deriving the consumption function even when taxes are assumed to be a function of income. They explain that assuming consumption to be a function of Y instead of Y_d (that is, $C = a + bY$ and $Y = C + A$) one can derive the consumption function as

$$C = \frac{a}{1-b} + \frac{b}{1-b} A.$$

Consequently, they state that "these equations demonstrate that, contrary to Hester's assertions, there is no inconsistency between our model and the treatment of taxes as induced (32, p. 372). Additionally, Friedman and Meiselman argue that using different autonomous expenditures requires a different dependent variable. They state that, if Hester wants to find how accurate his model is in predicting Y, it is necessary to use the difference between N and his autonomous concepts as the dependent variable (p. 374). Friedman and Meiselman (32) also explain that using the net foreign balance as autonomous does not mean that imports are taken autonomously. They (32) state: "Over a sufficiently long period of time, exports cannot possibly be autonomous . . . It seems plausible to suppose that the sum of these last two items can be regarded as autonomous over a long period" (p. 374).

Poole and Kornblith

The objective of Poole and Kornblith's (62, p. 908) study is to measure the performance of the equations offered by Friedman and Meiselman, Ando and Modigliani, Deprano and Mayer, and Hester for the 1959-1970 period. In doing so, they re-estimate all equations using all the alternative definitions of autonomous expenditures given by Friedman and Meiselman, Ando and Modigliani, Deprano and Mayer, and Hester over the 1929-1958 period. Poole and Kornblith (62) use the root-mean-squared-error (RMSE) as the criterion for measuing the performance (prediction power) of the alternative quation for the 1959-1970 period. The results of their study indicate that the performance of M_2 in all equations, whether the 1942-1946 is included or not, are generally similar. On the other hand, L' (as defined by Hester) outperforms the other alternative definitions when equations include the 1942-1946 period. However, the autonomous expenditure equation, L" (as defined by Hester), has the lowest RMSE than any equation when 1942-1946 is excluded (p. 910). The prediction results for the 1959-1970 period suggest that both the stock of money and the alternative definitions of autonomous expenditures underpredict consumption expenditures (p. 912). Therefore, Poole and Kornblith (62) state that:

> . . . the underprediction using M_2 alone is the result of the failure to take account of the interest elasticity of the demand for money . . . This explanation requires that the single equation approach be abandoned since at least one additional equation is required to explain the interest rate (p. 912).

Moreover, Poole and Kornblith (62) explain that the under-predictions of the Keynesian equations may be because of their failure to include taxes in their definitions of autonomous expenditures. However, the results of their study do not produce an accurate prediction for the 1959-1970 period. Consequently, they state that "the findings support the contention that neither the simple Keynesian nor the simple quantity theory models provide an adequate understanding of business cycle fluctuations" (p. 915).

Summary of Previous Studies

The major issues and differences among Friedman and Meiselman (31) and their critics can be classified in the following.

The Definition of a Monetary Variable and the Problem of Exogeneity. There is disagreement among Friedman and Meiselman and their critics in defining an exogenous monetary variable. Friedman and Meiselman (31) use M_2 as the exogenous monetary variable; whereas, Ando and Modigliani (6) compute an alternative monetary variable, M*. The critics argue that Friedman and Meiselman's definition of the monetary variable, M_2, cannot be an exogenous variable because of the two-way causation: M_2 affects consumption, C; and C affects M_2 by altering interest rates, borrowed reserves, and excess reserves. Thus, Ando and Modigliani (6) claim that using M* instead of M_2 can eliminate endogenous movements in monetary variable. This alternative definition of the monetary variable apparently is not objected to by Friedman and Meiselman (33) for the post-World War II period, but its reliability is questionable for the 1929-1933 period.[8]

The Time Period Studied. The second major difference between Friedman and Meiselman (31) and their critics is the use of different time periods. Hester (44) and Ando and Modigliani (6) use the data from the years 1929-1958, and Deprano and Mayer (19) use the 1929-1963, excluding the Second World War period, whereas Friedman and Meiselman (31) examine the whole period from 1897-1958. The reason for excluding the early years is based on the argument that, before 1929, the structure of the American economy is different;[9] and during the Second World War period people are prevented from achieving their desired level of consumption by government rationing. Friedman and Meiselman (33) object to including the period of the Great Depression by Ando and Modigliani (6) and argue that either they should examine the whole period from 1897-1958, or Ando and Modigliani should exclude the period of Great Depression from their study. They believe that, during the Great Depression, the collapse of the banking system may have disrupted the monetary mechanism in favor of autonomous expenditures.

Autonomous Expenditures and the Problem of Exogeneity. Friedman and Meiselman's (31) definition of autonomous expenditures differ

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[8]Friedman and Meiselman (33, pp. 780-781) object to using M* for 1929-1933 period and believe that the collapse of the banking system has caused a special institutional desire for excess reserves and that the excess reserves should not be eliminated.

[9]Before 1929, the U.S. has very low tax rates and the quality of the data is much worse. Also, monetary institutions have changed radically since 1929.

slightly from the others. Friedman and Meiselman (31) define autonomous expenditures A, as

> A = government expenditures (federal and states) - taxes of federal and states government + net exports of goods and services + producers' durable equipment + non-residential structure + residential structure + change in inventories - depreciation allowances + net foreign investment.

All of Friedman and Meiselman's critics claim that many of the Friedman and Meiselman's (31) components of autonomous expenditures are not exogenous and should be eliminated from the independent variable. For example, Deprano and Mayer (19) and Hester (44) believe that taxes, imports, inventory investment, and depreciation allowances are endogenous. Therefore, they want to eliminate these components from the definition of autonomous expenditures. On the other hand, Ando and Modigliani (6) want to eliminate unemployment insurance transfers,[10] taxes, imports, and inventory investment from A.

Unfortunately, in the 1950's and 1960's neither Friedman and Meiselman nor their critics have had a better method than the correlation coefficient analysis for assessing the exogeneity of their variables. But today the two newly developed econometric technqieus by Granger (40) and Sims (67) may cast light upon the presently unexplained problem. Thus, the exogeneity of the autonomous expenditures and the monetary variable, as defined by Friedman and Meiselman (31) and by their critics, will be tested by using these two tests of causality. These tests and their applications are discussed in more detail in the next chapter. However, in contrast to Friedman and Meiselman (31), this paper will study the 1929-1977 period due to the lack of data before 1929 for all

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[10]Unemployment insurance transfer is a part of the total government expenditure.

components of autonomous expenditure and monetary variables, as defined in Appendix A.

Andersen and Jordan and Their Critics

The second controversy over the determinants of changes in economic activity is initiated by Andersen and Jordan (2) in 1968. The primary objective of their study is to find out whether the response of economic activity to fiscal variables relative to that of monetary variables is greater, more predictable, and faster (p. 114). In doing so, Andersen and Jordan (2) regress the first difference of GNP on the first differences of a monetary and a fiscal variable and estimate it by using the Almon distributed lag technique for the period from the first quarter of 1952 to the second quarter of 1968. They explain that assuming gross national product, Y_t, as a function of G_t, T_t, M_t, and Z_t, then one can write

$$\Delta Y = a_1 \Delta G + a_2 \Delta T + a_3 \Delta M + a_4 \Delta Z, \qquad (7)$$

where G is the government expenditure variable, T is a variable summarizing government taxing actions, M is the monetary variable, and Z is a vector of all other forces that influence total spending. Andersen and Jordan (2) postulate a_1, a_2, a_3, and a_4 as the total response of ΔY to changes in each of the four independent variables. Andersen and Jordan argue that ΔZ is impossible to specify and measure correctly because all the forces influencing economic activity are not quantifiable. Consequently, they believe that this difficulty will be solved if $a_4 \Delta Z$ is replaced by a constant term. When this variable is replaced, they interpret the constant as the average value of $a_4 \Delta Z$ and estimate the following regression

$$\Delta Y = a_0 + a_1\Delta G + a_2\Delta T + a_3\Delta M + V_t \qquad (8)$$

In this regression they use the change in the high (full) employment expenditures and taxes[11] as exogenous fiscal variables and use the change in the monetary base and the change in the money supply as the exogenous monetary variables.[12] Their empirical results indicate that the beta coefficients[13] for the change in the monetary base and for the change in the money supply are greater than those for changes in the high employment expenditures and taxes. Moreover, Andersen and Jordan's (2, p. 123) results show that the sum of the regression coefficients for ΔG is approximately zero. Consequently, according to their tests, they conclude that the response of total demand to fiscal variables is not greater than that to monetary variables. Their empirical results also indicate that regression coefficients of monetary variables have higher t-values than those for fiscal variables. Additionally, they find that "the change in the monetary variable induces a larger and almost equal response in each of the four quarters" (2, p. 127). Therefore, these

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[11]High employment expenditure and taxes are the total government expenditures and receipts when the GNP is assumed at the full employment level.

[12]Edward Gramlich (39, p. 511) in defending the choice of monetary base as the exogenous monetary variable states that, "This choice relegates all private investment and state and local spending to the endogenous sector, thus ruling out arbitrary exogenous-endogenous decisions though probably implying longer lags for policy variables. At the same time, full employment taxes improve the coverage of exogenous fiscal variables by including tax rate changes which would have been missed by the autonomous expenditure variables of Ando and Modigliani, Deprano and Mayer, and Hester . . . using monetary base instead of money supply eliminates endogenous movements in excess reserves."

[13]Beta coefficients are equal to regression coefficients multiply by the ratio of the standard error of the independent variable to the standard deviation of dependent variable (54, p. 119).

results lead them to conclude that "the response of economic activity to monetary variables compared with that of the fiscal variables is (1) greater, (2) more predictable, and (3) faster" (2, p. 128).

DeLeeuw and Kalchbrenner

Andersen and Jordan's (2) study has raised new sets of criticisms and arguments in determining the primary source of change in GNP. One of their critics, Deleeuw and Kalchbrenner (21) pose their criticisms on using the high employment receipts and monetary base as the exogenous fiscal and monetary variables, respectively. First, they believe that, although full employment taxes are a better representation of exogenous tax policy, they are still endogenous with respect to price changes; that is, the full employment tax receipts in current dollars go up faster during a period of rapidly rising prices than they do during a period of price stability. DeLeeuw and Kalchbrenner's (21, p. 8) solution to this proposed problem is to multiply the full employment receipts by a ratio of this period's general price level to last period's general price level. Second, they argue that the monetary base cannot be regarded as an exogenous variable; for there is a strong tendency for movements in borrowing to be offset by movements in some other components of the base (p. 8). DeLeeuw and Kalchbrenner (21) explain that if the level of borrowing is one of the statistics which the Federal Reserve uses as an index of its effect on economic activity,[14] a rise (decline) in borrowing might provoke a reduction (increase) in unborrowed reserves in order to get the borrowing back to the expected level. Moreover,

[14]It has been during much of the 1950's.

DeLeeuw and Kalchbrenner (21) argue that during the sample period used by Andersen and Jordan (2) the Federal Reserve has focused on the money market data in judging its current effect. They state that:

> If there is an increase in the rate of growth of currency, as it was seven or eight years ago, it is not permitted to cause a lower rate of growth of unborrowed reserves unless the Federal Reserve happens to want a lower rate of growth of reserves for other reasons (21, p. 9).

Consequently, DeLeeuw and Kalchbrenner (21) assert that there is an endogenous movement in borrowed reserves and in currency; therefore, they suggest deleting them from the monetary base. Additionally, they believe that four quarter lags are not enough because the dependent variable in Andersen and Jordan's (2) study involves more than consumption; they suggest eight quarter lags instead. Their results indicate that (1) the monetary variable (unborrowed reserves) has a statistically significant regression coefficient and the size of its multiplier is smaller than that in Andersen and Jordan's study; (2) the full employment expenditures multiplier is raised significantly to 1.7; and (3) the full employment taxes have a slightly significant multiplier of -1.6. These results lead DeLeeuw and Kalchbrenner to conclude that fiscal policy appears to exert a significant influence on GNP in the expected direction, but monetary variable is also an important factor in determining changes in the economic activity.

Andersen and Jordan (3) accept the DeLeeuw and Kalchbrenner suggestion to adjust the total receipts for the price changes. But they do not agree to use unborrowed reserves as the exogenous monetary variable (p. 12). Andersen and Jordan argue that using unborrowed reserves rather than the monetary base, as in DeLeeuw and Kalchbrenner's study, is based upon a statistical argument,[15] but DeLeeuw and Kalchbrenner do not offer any theoretical reasoning for using unborrowed reserves as a measure of monetary influence. They point to DeLeeuw and Kalchbrenner's statement that "if there is an offset between unborrowed reserves and borrowed reserves, the borrowing should not be excluded from the base" (3, p. 15). Thus, Andersen and Jordan regress ΔR_u (change in unborrowed reserves) on ΔR_b (change in borrowed reserves) and show that ΔR_b and ΔR_u are negatively correlated. Consequently, they conclude that there is no justification for excluding borrowed reserves from the monetary base. Moreover, Andersen and Jordan argue that DeLeeuw and Kalchbrenner have overlooked the fact that the base is derived from a balance sheet of Treasury and Federal Reserve monetary accounts, but DeLeeuw and Kalchbrenner do not refer to the source of the base. Therefore, the dividing of the monetary base into borrowed reserves, unborrowed reserves, and currency without referring to the source of the base is inappropriate. Andersen and Jordan point that DeLeeuw and Kalchbrenner do not report the results of using total reserves as a measure of monetary variable. They state that:

> If DeLeeuw and Kalchbrenner had excluded currency held by the public from the base, but had not excluded borrowing, their results would have been sufficiently similar to those obtained using total base or the money supply that none of the major conclusions of our original article would be changed (3, p. 16).

Davis

Davis (17) criticizes the use of the money supply and the monetary

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[15] DeLeeuw and Kalchbrenner (21) believe that there is an endogenous movement in borrowed reserves and in currency and they are not statistically independent of the disturbance terms of the Andersen and Jordan single equation model.

base in Andersen and Jordan's (2) study as the exogenous monetary variable. He believes that there is a two-way causation from the base to GNP and from GNP to the base; that is, borrowed reserves in not exogenous, because interest rates, current business condition, and the state of loan demands influence the demand for borrowed reserves. Davis (17, p. 125) then argues that the currency which the public wishes to hold is not exogenous either, because "the banks supply the public with currency on demand, and during the period of the 1950's and 1960's, the Federal Reserves had more or less automatically replenished the reserves lost by the banking system through currency drains." He apparently is not convinced of Andersen and Jordan's (3) arguments in reply to Deleeuw and Kalchbrenner regarding the exogeneity of currency and borrowed reserves. He points that the negative correlation between changes in borrowed reserves and changes in unborrowed reserves, reported by Andersen and Jordan (3), can also be found if the Federal Reserve use either unborrowed reserves or borrowed reserves as an operational target. Consequently, he (17) writes:

> A deliberate increase in unborrowed reserves would tend to make banks pay off borrowings. Similarly, a deliberate increase in the level of borrowed reserves would have to be engineered by a subtraction of unborrowed reserves (p. 125).

Davis (17) re-estimates the Andersen and Jordan's reduced form equation (St. Louis model) for the periods 1952-1960, 1952-1968, and 1960-1968, using quarterly data. His results indicate that the explanatory power of monetary variable is very low when the St. Louis equation is fitted to the 1952-1960 data; but the St. Louis equation fits the data well in the 1960's. The reason he gives for this result is that "there is a strong common time trend in changes in money and in GNP present in the 1960's but not in the earlier period" (17, p. 123).

Davis also tests unborrowed reserves, proposed by DeLeeuw and Kalchbrenner (21) as the exogenous monetary variable, to find whether or not it has a higher explanatory power. He finds that unborrowed reserves can explain 54 percent of the variance of quarterly changes in money. This result leads him to conclude that using unborrowed reserves rather than the monetary base as the exogenous monetary variable decreases the explanatory power of the regression substantially. Consequently, in spite of the fact that Davis (17) unconvinced by Andersen and Jordan's reply to DeLeeuw and Kalchbrenner, he states that "in defense of the St. Louis equation, however, one may argue that the total base is in fact a more appropriate 'exogenous' variable than the unborrowed reserves" (17, p. 128).

Silber

Silber's (66) major interest is in the following questions: (1) Would extension of the length of the lag on the exogenous variables have any effect of the reported impact of monetary and fiscal policy by Andersen and Jordan (2)? (2) Is there a structural change in the St. Louis reduced form equation during the period of 1953-1969? (3) Would the impact of fiscal policy be increased by including the financing side of a deficit? (4) Is there any impact of other exogenous variables on GNP? In answering the first two questions, Silber (66, p. 362) re-estimates the Andersen and Jordan equation for the 1953-1969 period, and the subperiods 1953-1960 and 1961-1969 using quarterly data. The results of this experiment support the fact that the length of the lag for monetary base, MB, does not have any impact on the efficacy of fiscal policy for the whole period of data 1953-1969; but shortening the length of the lag for MB reduces the size of fiscal impact on GNP during 1961-1969 period (pp. 363-364). With regard to the last two questions, Silber (66, p. 366) adds government bond variable,[16] total exports, consumption lagged one period, and GNP lagged one period to the Andersen and Jordan equation. He reports that the estimated regression coefficients for all variables are small and insignificant (p. 366). Silber (66, p. 366) is quite unsatisfied with these results and states that "since the current and lagged debt variables were insignificant (t-values less than .5), the empirical mechanism leading to a net zero (or very small) fiscal impact remains in serious doubt."[17] Moreover, he points that to the extent the added variables and

> . . . the structural equation are realistic, there ought to be some impact of these variables on GNP. Since these lagged variables are insignificant in the reduced form equation, some question arises as to the validity of the reduced form approach (66, p. 366).

However, the re-estimation of Andersen and Jordan's equation for the 1961-1969 period results in significant regression coefficients for all variables (p. 367). Consequently, Silber (66, p. 367) states that both money and fiscal variables are important in determining the economic activity.

Gramlich

Another critic of Andersen and Jordan's (2) study, Gramlich (39),

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[16]The government bond variable is total government debt including savings bond less Federal Reserve holdings. Silber (66, p. 366) uses that as a measure of financing the side of a deficit.

[17]Silber (66, p. 366) states that "the net fiscal impact would be derived by summing the coefficients of the current and lagged fiscal variables to get the pure fiscal impact and then adding to that the impact of a change in debt in each period."

defines expenditures and taxes in a slightly different form to find out whether or not they alter Andersen and Jordan's results. He divides the federal budget into those budgetary items which affect final demand directly and those items which affect final demand through household consumption behavior.[18] Additionally, Gramlich uses eight different dependent variables and three measures of monetary variables represented by monetary base, free reserves, and borrowed reserves.[19] Moreover, he tests the possibility of existence of non-linearities in his regressions and multiplies the monetary variable, the expenditure variable, and the tax variable by the unemployment rate and use them as separate lagged independent variables. He reports that the non-linear terms do not have significant coefficients; therefore, he omits them for all

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[18]Gramlich (39, p. 516) defines the first items as sum of government purchases and grants-in-aid, which in simple Keynesian system has a multiplier of 1/(1-c) where c is marginal propensity to consume. His second set of items consists of full employment personal taxes plus full employment social insurance contributions (adjusted for inflation) minus total transfers to persons excluding unemployment insurance benefits minus interest payments which have a multiplier of c/(1-c).

[19]The eight sets of reduced form equations used in Gramlich's (39) study are:

a. GNP in current dollars as dependent variable and M (monetary variable), E (first budgetary items), T (second budgetary items), and S (strike dummy) as independent variables;

b. Real income is regressed on real values of M, E, T, and S;

c. Moody's Aaa corporate bond rate is the dependent variable and current values of M, E, and T are independent variables;

d. Plant and equipment investment expenditures in current dollars, using the set in b;

e. Personal consumption expenditures in current dollars, using the set in b;

f. Residential consumption expenditures in current dollars, using the same set of variables in b;

g. Inventory investment in current dollars, using T, E, and M in current dollars and using S;

h. Saving and loan deposits in current dollars, using the set of variables in b.

regressions (p. 519). The results of Gramlich's (39, pp. 519-523) study indicate that unborrowed reserves, among the other monetary variables, performs much better in all reduced form equations. Additionally, he points that "the reduced form equations using the monetary base as exogenous gives the outlines of an orthodox monetarists, or money mostly, for the short and intermediate run determination of aggregate demand"[20] (p. 520). On the other hand, Gramlich (39, p. 521) states that "we can characterize the free reserves exogenous equations as giving an orthodox Keynesian, or fiscal policy mosly, interpretation of the macro-system".[21] The higher R^2 for the regression including unborrowed reserves leads him to argue that unborrowed reserves is a better indicator of exogenous monetary variable than the other two monetary variables (monetary base and free reserves). Further, he concludes that both monetary and fiscal variables are important in determining changes in GNP.

Gordon

The other critic of Andersen and Jordan's (2) study, Gordon (38), apparently is not convinced with the work that Gramlich (39) has done. In a comment of Gramlich's paper he criticizes Gramlich and the other followers and critics of Andersen and Jordan's study on the grounds that the St. Louis equation should have been estimated by expressing

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[20]The empirical results show significant and high coefficients of 11.28 and 7.17 for M in equations (a) and (b), but low and insignificant coefficients of 0.5 and 0.8 for E, and slightly significant coefficients of -2.15 and -3.25 for T, respectively (p. 519).

[21]His results indicate significant coefficients of 3.2 and -4.03 for E and T, respectively, but insignificant coefficient of 14.2 for M (p. 522).

variables as relative changes rather than as absolute changes. Gordon (38, p. 537) argues that assuming Y = MV and postulating that velocity (V) is a function of a constant, a time trend, and the interest rate (r), the following equation can be derived:

$$g_y = \alpha + \beta g_M + \gamma g_r + u$$

where g_y, g_M, and g_r are the percentage changes in Y, M, and r, respectively. Consequently, he believes that the monetarist equations should have been calculated for relative instead of absolute changes. Gordon (38) then states that:

> This equation is extremely important, since it invalidates the theoretical rationale for Andersen and Jordan's claim that an expansion in government spending unaccompanied by change in the money supply has no effect on income because it 'crowds out' an equal amount of private expenditures.
>
> An increase in government spending financed by borrowing with the money supply held constant will yield a net increase in current-dollar GNP if the demand for money is interest-elastic, since the increase in interest rates which accompanies the borrowing induces the original holders of money balances to release a portion of their balances to finance the increase in GNP (p. 538).

Gordon also criticizes using the monetary base as an exogenous monetary variable. He believes that having a large multiplier for monetary base as reported in Andersen and Jordan's study, is partially due to the fact that monetary base is not exogenous. He (38) further states that:

> Since reduced-form equation appears to be incapable of setting debates and arguments on the choice of exogenous monetary and fiscal variables are likely to continue forever, the discussion seems to point back to large-scale econometric models (p. 543).

Blinder and Solow

The major argument of Blinder and Solow (11, p. 66) is that Andersen and Jordan's estimation of equation (8) rather than equation (7), results in the inclusion of $a_4\Delta Z$ into the error term; that is, $V_t = e_t + a_4\Delta Z - a_0$. Hence, if ΔZ is correlated with ΔG, ΔT, and ΔM, then application of OLS on equation (8) would yield biased and inconsistent estimates of the parameters. Additionally, they believe that changes in the full employment surplus, used by Andersen and Jordan (2) as a measure of fiscal variable, is not a correct specification of fiscal variable. Rather, they suggest to use the change in the weighted standardized surplus as a measure of the fiscal variable.[22] Consequently, Blinder and Solow (11, p. 69) argue that the use of incorrect measure of fiscal variable by Andersen and Jordan (2) "has biases the coefficient for fiscal variable toward zero."

Lombra and Torto

Lombra and Torto (52) question the exogenity of the monetary base in the St. Louis reduced form equation. They (52) argue that the supply and the demand for money are not independent:

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[22]Blinder and Solow (11, pp. 67-69) compute the change in the fiscal variable as $ds = C_y\ T_t\ (y,t)\ dt - dG$, where C_y is the partial derivative of consumption function with respect to y; y is the total income; t is tax rate; T_t is the partial derivative of tax function with respect to tax rate; and G is government expenditures. They call ds the change in the weighted standardized surplus. Blinder and Solow point out that Andersen and Jordan (2) treat ds as equivalent to the change in the weighted full employment surplus $dw = C_y\ T_t\ (y^*,t)\ dt - dG$, where y^* is income at the full employment level. But, during the period in which Andersen and Jordan (2) conclude their study the economy is far from full employment. Therefore, they believe that dw is not a good proxy for ds.

> The Federal Reserve's open market operations, in part, accommodated increases in the demand for money during the test period used by Andersen and Jordan and that as a result of such behavior by the monetary authorities the monetary base is an endogenous variable (p. 14).

Lombra and Torto (52, p. 50) hypothesize that the majority of open-market operation cannot be explained by the systematic response of the Federal Reserve to changes in economic activity; that is, the Federal Reserve response to changes in economic activity is a function of the money market stability desired by policy makers. They regress the change in the Federal Reserve holdings of government securities (ΔGG) on the sum of the sources of the monetary base (ΔA),[23] the change in borrowed reserves (ΔB), the change in required reserves (ΔRR), and the change in currency (ΔCC) to test whether or not their hypothesis is correct. Their results indicate negative and significant regression coefficients for ΔA and for ΔB but positive and significant regression coefficients for ΔRR and for ΔCC, respectively (p. 51). Therefore, Lombra and Torto (52) argue that an increase in A is partially offset by the monetary authorities selling government securities. Further, they state that "the negative sign on ΔB indicated offsetting actions by the authorities with regard to this variable" (p. 51). On the other hand, the positive coefficients for ΔRR and ΔCC lead them to conclude that "the hypothesis of accommodating action" is supported by the monetary authorities (p. 51). Therefore, they emphasize that "accommodations by the authorities of changes in required reserves and changes in currency will lead to changes in the monetary base" (p. 51). Consequently, Lombra and Torto oppose the use of monetary base as an exogenous monetary variable in Andersen and Jordan's equation. Instead,

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[23] "For example, gold stock, float, etc." Lombra and Torto (52, p. 50).

they (53) construct a "neutralized monetary base" measured as

$\Delta MB^* = \Delta MB - \Delta GG'$ [24]

and they re-estimate the St. Louis reduced form equation for 1952-1968 using quarterly data (pp. 105-106). Their results, in comparison with the Andersen and Jordan's (2) results, show a lower regression coefficient for ΔMB^*, but rather a higher and significant regression coefficient for the change in high employment expenditures. Consequently, Lombra and Torto (53, p. 106) conclude that neutralization of the monetary base reduces the impact of the monetary variable on GNP, but still money matters, and significantly so, and at the same time so does fiscal policy.

Waud

Waud's (74) study is quite different from the study of the other critics. Waud (74, p. 177) argues that in all studies of the relative efficiency of monetary policy vis-a-vis fiscal policy in achieving economic stability and regulating economic activity, the structural model that serves as a basis for the "so called reduced form equation" is unclear. Therefore, he suggests using the "employment of production worker man-hour at the SIC (Standard Industrial Classification) two-digit industry level" rather than GNP as the dependent variable (p. 177). He hopes to examine unsolved problems of determining the direction of causation between independent and dependent variables in the St. Louis reduced form equation. Waud (74, pp. 178-179) defines his reduced

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[24]$\Delta GG'$ are the estimates of ΔGG that obtained by regressing ΔGG on ΔA, ΔB, ΔRR, and ΔCC.

form equation as

$$\ln L = a_0 + a_1 t + a_2 \ln K + a_3 \ln X + a_4 \ln R + a_5 \ln M + a_6 \ln W_1$$

where ln is the natural log, K is the capital stock, X and R are high employment expenditures and taxes, M is a monetary variable, and W_1 is the total hourly cost of production worker man-hours L. His main argument in using this reduced form equation rather than the original St. Louis equation is based on the grounds that there is a two-way causation from money to GNP and from GNP to money. Therefore, he believes that one way to solve the problem is to use different dependent variables. Waud (74, p. 179) introduces five alternative definitions of monetary variables, MB, M_1 (currency in public circulation plus adjusted demand deposits), M_2 (M_1 plus time deposits in commercial banks), M_3 (M_2 plus mutual saving bank deposits plus postal savings accounts plus savings and loan association shares, and MT (the ratio of the market value of the stocks and bonds of nonfinancial corporations to the replacement cost of their plant and equipment). He then argues that, because all definitions of money, except MT, are highly correlated with X and R, the matrix of the independent variables is singular. Therefore, only MT can be used as the proper measure of monetary variable in the reduced form equation. The results of estimating his reduced form equation, using Almon distributed lag, clearly report that both money and expenditures perform alike. Consequently, his empirical findings lead him to conclude that "fiscal influences and monetary influences on economic activity are both significant and appear equally important" (p. 177).

Elliott

Elliott (24) questions whether different forms of distributed lag techniques yield conclusions that differ from the Andersen and Jordan (2) findings. Additionally, he tests the exogeneity of the leading and lagging government expenditures and money supply by using the newly developed Sims' test of causality. The results of using three alternative distributed lag techniques (Almon, smoothness priors, and unrestricted least squares) consistently support the conclusion that the relative dominance of monetary over fiscal influences observed in the original St. Louis estimates does not depend upon the choice and length of the lag structure (24, pp. 185-186). But the results of Sims' test indicate that both distributed lead and lag of government expenditures are significant while the money supply term is exogenous. Thus, Elliott (24) states that:

> . . . in order to insure reliability in the measured monetary and fiscal weights in light of this result, it is necessary that the St. Louis equation contain a distributed-lead government sequence in addition to the original specification. Then, the weights associated with this entire lead-lag government sequence constitute the correctly specified government impact (p. 188).

Elliott estimates this modified St. Louis equation over the identical time period of the initial study.[25] The results of this estimation indicate that the coefficients of monetary variable drop slightly, but the coefficients of government expenditures increase from the original 0.14 to 0.23 (p. 188) However, the results are essentially unaltered by inclusion of the distributed-lead expenditures. Therefore,

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[25]The time period of his initial study is from the first quarter of 1953 to the fourth quarter of 1969.

he concludes that fluctuations in nominal GNP are more clearly linked to monetary movements than to movements in federal expenditures (p. 190).

Mehra

Similar to Elliott's (24) study, Mehra (57) tests the use of different distributed lag techniques (Almon and unrestricted distributed lag) in the St. Louis reduced form equation. Moreover, he uses the Sims' technique to test the exogeneity of the change in monetary base in relation to change in nominal GNP, change in real income, and change in GNP price deflator, respectively. Additionally, Mehra (57, p. 156) investigates the impact of monetary policy on the relevant variables (nominal GNP, real income, and price index) by employing lag periods reaching back 4, 8, 12, and 16 quarters to see whether the results vary significantly with the length of the lag distribution. His results indicate, first, that the change in the monetary base in relation to changes in nominal and real income is strictly exogenous while it is endogenous with respect to price changes. Second, the Almon and unrestricted distributed lag lead to the same results. Third, although the accumulated monetary policy weight on nominal GNP is not changed significantly as the length of the lag distribution is increased to 8, 12, and 16 past quarters, the effect of monetary policy on real GNP and the price level changes significantly (p. 160). Mehra (57, p. 166) therefore, concludes that:

> Monetary policy changes as measured by first difference in monetary base do not have predictable effects upon the first differences in the nominal income and the general price level, whereas the long run value of real income is unaffected by changes in the monetary base. In the short run, however, monetary policy changes do bring about changes in the income.

Other Andersen and Jordan's Critics

The major contentions of other critics of Andersen and Jordan (2) including Friedman (25), Goldfeld and Blinder (37), and Vrooman (72), are mostly related to the selection of the exogenous monetary variable and correct specification of the reduced form equation. Friedman (25) re-estimates the St. Louis equation for the data from the first quarter of 1953 through the second quarter of 1976. His results yield a significant coefficient of 1.5 for government expenditures (p. 366). Moreover, he finds that monetary variable continue to hold a relatively strong impact on GNP. However, the results of his study lead him to conclude that "the St. Louis model now believes in fiscal policy" (p. 367).

Carlson (14) in a 1978 study disagrees with Friedman (25). His major criticism is based on statistical problems he sees in Friedman's (25) updated study. Carlson (14, p. 17) uses the Goldfeld-Quandt test and shows that the variance of the disturbances in Friedman's study is not constant for the period of 1975_I-1976_I. Therefore, he states that the existence of heteroscedasticity in that period affects the standard error of the coefficients. Consequently, the coefficients of some variables become significant. Carlson (14, p. 17) then suggests the alternative of expressing all variables in the equation in rate-of-change form. His results of re-estimating the St. Louis model indicate that fiscal policy does not matter and he concludes that "the evidence does not support the conclusion that the St. Louis equation now believes in fiscal policy" (14, p. 17).

Summary of Previous Studies

The aforementioned studies suggest the following major issues and differences among Andersen and Jordan (2) and their critics.

Monetary Variables and the Problem of Exogeneity. There is basic disagreement among Andersen and Jordan (2) and their critics in defining an exogenous monetary variable. Andersen and Jordan use MB as the exogenous monetary variable, whereas DeLeeuw and Kalchbrenner (18) believe that there is an endogenous movement in borrowed reserves and currency. Hence, they delete them from the monetary base. Similarly, Gramlich (39) tests the performance of three alternative monetary variables, monetary base, free reserves (FR), and unborrowed reserves (UR), and he argues that because UR increases the explanatory power of the regression, unborrowed reserves is a better proxy for the exogenous monetary variable. Lombra and Torto (53) use a neutralized monetary base variable defined as $\Delta MB^* = \Delta MB - \Delta GG'$.[26] They believe that this new definition of monetary variable (or adjusted monetary base) eliminates the endogenous movements in MB. Waud (74), on the other hand, uses MT (the ratio of the market value of the stocks and bonds of nonfinancial corporations to the replacement cost of their plant and equipment) in his new reduced form equation. He hopes that the use of MT variable in his reduced form equation would solve the problem of two-way causation between GNP and MB. Mehra (57) and Elliott (24) both use the Sims test of causality in their studies. Elliott (24) tests the exogeneity of money supply and finds that money supply is exogenous. On the other hand, Mehra (57) examines the

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[26] $\Delta GG'$ is defined in footnote 24.

exogeneity of the change in monetary base in relation to change in nominal GNP, change in real income, and change in GNP price deflator, respectively. He finds that the change in the monetary base in relation to changes in nominal and real income is exogenous while it is endogenous with respect to price changes.

Fiscal Variable and the Problem of Exogeneity. Andersen and Jordan (2) define fiscal variables as the change in full employment expenditures and taxes. But this definition of fiscal variables is criticized by DeLeeuw and Kalchbrenner (18), Blinder and Solow (11), Gramlich (39), and Elliott (24) on the grounds that it is neither exogenous nor is it a good measure of fiscal variables. For example, DeLeeuw and Kalchbrenner (18) argue that although full-employment taxes are a better indicator of exogenous tax policy, full-employment taxes are still endogenous with respect to price changes. Thus, they suggest that the full-employment receipts be multiplied by a ratio of this period's general price level to last period's general price level, a variable whi which is accepted by Andersen and Jordan (3). Gramlich (39), on the other hand, defines different forms of expenditures and taxes. He divides the federal budget into those budgetary items which affect final demand directly and those items which affect final demand through household consumption behavior. His only argument in defining the two budgetary items is that the two tax and expenditure variables in Andersen and Jordan's (2) study includes "heterogeneous components"; thus the coefficients of tax and expenditure variables do not come through clearly. But he does not address any statistical argument in support of defining those budgetary items. In contrast to DeLeeuw and Kalchbrenner (18) and Gramlich (39), Elliott (24) applies the Sims' test of causality and finds that both distributed-lead and lag of government expenditures are significant. Thus he suggests that the St. Louis equation contains a distributed-lead government sequence in addition to the original specification.

Blinder and Solow (11) also believe that the change in the full-employment expenditures or surplus is not a good measure of fiscal variables. Rather, they suggest that the change in weighted standardized surplus is a correct measure of fiscal influences on GNP.

Different Distributed Lag Techniques and Their Applicabilities. The other major area of differences among Andersen and Jordan (2) and their critics relates to distributed lag techniques. Elliott (24) applies three alternative lag techniques (Almon, smoothness priors, and unrestricted least squares) to investigate whether the Andersen and Jordan results are different. Mehra (57) tests the use of two different distributed lags (Almon and unrestricted distributed lag) on Andersen and Jordan's single equation model. Both of these studies conclude that the relative impact of monetary variable over fiscal variable does not depend upon the choice of the lag structure. Moreover, DeLeeuw and Kalchbrenner (18) and Mehra (57) increase the length of the lag to investigate the relative impact of monetary and fiscal variables further. DeLeeuw and Kalchbrenner claim that because the dependent variable in Andersen and Jordan's study involves more than the consumption, four quarter lags are therefore, not enough. They suggest eight quarter lags instead. DeLeeuw and Kalchbrenner's results do not show a significant change in the performance of monetary and fiscal variables when the change in the adjusted monetary base is used as a measure of monetary variable. But it significantly increases both the influences of money and expenditures on GNP when ΔUR is used as the measure of influence of money on economic activity.

CHAPTER III

METHODOLOGY

The objective of this paper is to study the following issues and problems:

1. To determine the exogenous components of autonomous expenditures and monetary variables in Friedman and Meiselman's (31) study.
2. To find the exogenous components of monetary variables in Andersen and Jordan's (2) study.
3. To use the proper measure of fiscal variable in Andersen and Jordan's study.
4. To test the sensitivity of Andersen and Jordan's (2) results to different distributed lag structural techniques.

The first two issues are studied through use of the recently developed tests of exogeneity by Granger (40) and Sims (67). In this endeavor, all the alternative definitions of autonomous expenditures and monetary variables and their components given by Friedman and Meiselman (31) and their critics, and the different definitions of monetary variables suggested by Andersen and Jordan (2) and their critics are tested by these two procedures. Accordingly, Section 1 provides the reader with a general review of the test statistics. The third issue is studied and re-examined by using the change in the weighted standardized deficit, as suggested by Blinder and Solow (11, p. 69), as a measure of fiscal policy rather than the change in full-employment expenditures used by Andersen and Jordan (2). Finally, in addition to the Almon distributed lag applied by Andersen and Jordan (2), Koyck, Pascal, and rational distributed lags are used in this study to find out whether Andersen and Jordan's results could be different if they have applied a different distributed lag technique in their study.

Section 1: Tests for Exogeneity

Granger's Test of Causality

According to Granger (40, p. 428), ". . . we say that X_t is causing Y_t if we are better able to predict Y_t using all available information than if the information apart from the X_t had been used." Therefore, if assuming U_t is the set of all available information including X_t and $U_t - X_t$ is the set of the available information excluding X_t, one can say that X_t is causing Y_t if and only if $Var(Y_t|U_t) < Var(Y_t|(U_t - X_t))$. In this case, the notation $X_t \rightarrow Y_t$ is used to indicate that X_t is causing Y_t. This definition of causality given by Granger (40) is based entirely on the predictability of some time series, say Y_t. Therefore, if the time series X_t contains information that can help to predict Y_t, then X_t can be called an exogenous variable.

Zellner (75) has criticized this definition of causality. First, as recognized by Granger (40), the complexity of finding all relevant informations makes his definition nonoperational in practice for some groups of time series. Second, Zellner (75, p. 37) says:

> Granger's definition of causality is unusual in that it embeds a particular confirmatory criterion, the variance of the forecast error of an unbiased least squares predictor . . . and for most processes, even just stationary processes, an unbiased, least squares 'optimum predictor' is often not available.

Granger is aware of these problems in reaching an econometric form of causality relationship that can be tested. He argues that even if the optimum predictors are known and are non-linear, it seems natural to use only linear predictors; and the above definitions may again be used under this assumption of linearity (40, p. 430). Therefore, he says "the original definition of causality has now been restricted in order to reach a form which can be tested" (p. 430). According to him, assuming Y_t and X_t are covariance stationary time series, one can write:

$$Y_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + u_t$$

where u_t is white noise.[1] In this particular case $X_t \rightarrow Y_t$ if some $a_j \neq 0$. Therefore, if accepting the hypothesis that all a_j's are equal to zero then $X_t \not\rightarrow Y_t$ or Y_t is exogenous. On the other hand, if that hypothesis is rejected, then $X_t \rightarrow Y_t$.

<u>Application of the Granger Test in the Study of Friedman and Meiselman and Their Critics</u>. This test is applied to each of the components of autonomous expenditures and the monetary variables as defined by Friedman and Meiselman (31) and by their critics. Granger's (40) test requires estimating two regressions. For example, the following two regressions are estimated by OLS method, for 1929-1977 annual data, to test whether or not the autonomous expenditures (A) is exogenous.[2]

$$A_t = a_1 + \sum_{j=1}^{4} b_j C_{t-j} + \sum_{j=1}^{4} c_j A_{t-j} + u_t \quad \text{(unrestricted regression)} \qquad (9)$$

$$A_t = a_2 + \sum_{j=1}^{4} d_j A_{t-j} + u_t \quad \text{(restricted regression)} \qquad (10)$$

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[1]A "white noise" is a serially uncorrelated time series process with mean zero and constant variance σ^2.

[2]The reason for using four period lags is to give enough time to the independent variable to have a better response if there is any.

where a_1 and a_2 are constant and C is the consumption expenditure. Assuming that URSS and RRSS are unrestricted and restricted residuals sum squared obtained from these two regressions (using OLS method) respectively, the calculated F-statistics can then be estimated as

$$F = \frac{(RRSS - URSS)/4}{(URSS/(n-9)}$$

where n is the number of observations. In this case A can be considered to be an exogenous variable in relation to the consumption expenditures when the value of calculated F-statistics is less than the value of tabulated F-statistics with degree of freedom equal to four and (n-9).

Application of the Granger's Test in the Study of Andersen and Jordan and Their Critics. The defined measures of the monetary and fiscal variables given by Andersen and Jordan (2) and by their critics are also examined by Granger's test to find out whether they are exogenous. For example, the two required regressions for the monetary base are formulated as:[3]

$$\Delta MB_t = a_1 + \sum_{j=1}^{6} b_j \Delta GNP_{t-j} + \sum_{j=1}^{6} c_j \Delta MB_{t-j} + u_t \quad \text{(unrestricted regression)} \qquad (11)$$

$$\Delta MB_T = a_2 + \sum_{j=1}^{6} d_j \Delta MB_{t-j} + u_t \quad \text{(restricted regression)} \qquad (12)$$

These two regressions are estimated by OLS method using the 1952-1977 quarterly data. The calculated F-statistics, similar to that in the study of Friedman and Meiselman (31) and their critics, is estimated and compared with the tabulated F-statistics at 5 percent level with

[3]The reason for using six period lags is to give enough time to the independent variable to have a better response if there is any.

the degrees of freedom equal to six and (n-13). Large tabulated F-statistics in comparison with small calculated F-statistics indicates that the monetary base is an exogenous variable in relation to GNP.

Godfrey's Test for Higher Order of Serial Correlation. The regressions are all tested for existence of different orders of serial correlation. But the Durbin-Watson statistics are inappropriate in this type of model using the lagged dependent variable as regressors. Therefore, the newly developed test by Godfrey (36) is applied to investigate the presence of serial correlation in regression equations when the regressors include lagged dependent variables. Godfrey has proposed a procedure for determining an autoregressive and moving average (ARMA)[4] disturbances when the regressors include lagged dependent variables. He has developed a Lagrange multiplier test of the assumed error model against the specified ARMA alternative. The forumla for the hypothesis that $U \sim IID(0,\sigma^2)$ [5] is as follows:

$$L = \underline{\hat{u}}'\hat{U}_n[\hat{U}_n'\hat{U}_n - \hat{U}_n'X(X'X)^{-1} X'\hat{U}_n]^{-1} \hat{U}_n'\underline{\hat{u}} / \hat{\sigma}^2$$

where $\underline{\hat{u}}_i = (0, \ldots, 0; \hat{u}_1, \ldots, \hat{u}_{t-i})$,

$\hat{U}_n = (\underline{\hat{u}}_1, \ldots, \underline{\hat{u}}_n)$,

X = matrix of regressors,

$\hat{u}_1, \ldots, \hat{u}_{t-i}$ = residuals of the estimated regression,

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[4]The example of an ARMA(p,q) model, mixed autoregressive order p and moving average of order q, is as follows:

$$Y_t = \phi_1 Y_{t-1} + \ldots + \phi_p Y_{t-p} + \delta + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \ldots - \theta_q \varepsilon_{t-q}$$

[5]$U \sim IID(0, \sigma^2)$ means that the residuals from the regression $Y = Xb + U$ are independently and identically distributed with mean zero and variance σ^2.

σ^2 = estimated variance of the residuals, and

$i = 1, \ldots, n$.

When this statistic is compared with the χ^2 variate with r (hypothesized order of serial correlation or moving average) degrees of freedom, a significantly large value of L implies that the alternative hypothesis is consistent with the sample data. For example, to test AR(0) against AR(2), i.e., autoregressive of order 2, in the unrestricted regression for A (equation 9), he suggests the regression

$$u_t = \alpha_0 + \alpha_1 u_{t-1} + \alpha_2 u_{t-1} + \sum_{j=1}^{4} \gamma_i C_{t-i} + \sum_{j=1}^{4} \beta_i A_{t-i} + \xi$$

and the comparison of $TR^2 = L$ to the selected critical value for a χ^2_2 variate, where T is the number of observations. If the test statistic is significantly large, it indicates that the hypothesis is not consistent with the sample data. Therefore, the non-linear least square method is used to correct the determined order of serial correlation among the residuals of the regressions (9), (10), (11), and (12). The F-statistics for Granger's test, are calculated by using the residuals sum squares from the regressions that are corrected for the serial correlation among the residuals.

Sims' Test of Causality

An alternative way of testing the direction of causation is proposed by Sims (67). Assuming X and Y have zero covariance and are jointly purely linearly indeterministic, Sims (67) proves that Y does not cause X if and only if the residuals from the regression of Y on current, past, and future X's are not correlated with these regressors. He then argues that this test is equivalent to Granger's test of causality and proposes his test for exogeneity of X by regressing Y on past, present, and future X's and testing the hypothesis that the coefficients of future X's are zero. Therefore, he writes:

$$Y_t = \sum_{j=-k}^{m} a_j X_{t-j} + \varepsilon_t$$

where ε_t are serially correlated residuals. In Sims' test $X_t \rightarrow Y_t$ or X_t is exogenous if $a_j = 0$ for all $j < 0$. This test differs from Granger's test in that the residuals are serially correlated. Therefore, if one wishes to make a fairly precise use of F tests on groups of coefficients, the residuals must be corrected for serial correlation. In his study, Sims (67) measures all variables in natural logs and multiplies them by $(1-.75L)^2$ where L is the lag operator. He hopes that this operation will eliminate the serial correlation and that the disturbances will therefore be white noise.

Application of the Sims Test in the Study of Friedman and Meiselman and Their Critics. To further examine whether the autonomous expenditures and the monetary variables, as defined by Friedman and Meiselman (31) and by their critics, are exogenous, Sims' (67) test is applied to each variable by estimating two regressions. These two regressions for the autonomous expenditures (A) are formulated as

$$C_t = a_1 + \sum_{j=-2}^{2} b_j A_{t-j} + cT_t + u_t \qquad \text{(unrestricted regression)} \qquad (13)$$

$$C_t = a_2 + \sum_{j=0}^{2} d_j A_{t-j} + eT_t + \varepsilon_t \qquad \text{(restricted regression)} \qquad (14)$$

where C is the consumption expenditures; a_1 and a_2 are constants; and T is a time variable equal to the years 1929-1977. After correcting for serial correlation, a significantly large value of F-statistic calculated as

$$F = \frac{(RRSS - URSS) / 2}{URSS / (n-6)}$$

indicate that the independent variable (in this example, the autonomous expenditures, A) is not exogenous.

Application of the Sims Test in the Study of Andersen and Jordan and Their Critics. This test, similar to the Granger's (40) test, is used to investigate the exogeneity of the defined measures of the monetary and fiscal variables by Andersen and Jordan (2) and by their critics. Accordingly, the unrestricted and the restricted regressions for examining the exogeneity of the monetary base are as follows:

$$\Delta GNP = a_1 + \sum_{j=-4}^{4} b_j \Delta MB_{t-j} + cT_t + v_t \qquad \text{(unrestricted regression)} \qquad (15)$$

$$\Delta GNP = a_2 + \sum_{j=0}^{4} d_j \Delta MB_{t-j} + eT_t + u_t \qquad \text{(restricted regression)} \qquad (16)$$

where T is a time variable equal to the first quarter of 1952 through the fourth quarter of 1977; and a_1 and a_2 are constants. These two regressions are estimated by using OLS method and the 1952-1977 quarterly data. In this test, ΔMB will be exogenous if the calculated value of F-statistic

$$F = \frac{(RRSS - URSS) / 4}{URSS / (n-11)}$$

is less than the tabulated F-statistic at the 5 percent level with 4 and (n-11) degrees of freedom.

In contrast to Sims, the natural log and filtering procedure are not used for producing a white noise disturbance in this study. The natural log is not used because this study attempts to be as close to Friedman and Meiselman's (31) and to Andersen and Jordan's (2) study as possible.[6] Also, Sims' filtering procedures is not used because he has not been successful in obtaining the white noise disturbances. Instead, the disputed problem, serial correlation, is corrected for by using non-linear least square procedure. A low and nonsignificant Durbin-Watson statistic in regression (13), (14), (15), and (16) indicate that the disturbances are not white noise. Therefore, each regression is corrected for, up to the fourth order of serial correlation by using the non-linear least square procedure.

Section 2: Solution to the Incorrect Measure of Fiscal Policy

The third controversial issue raised by Blinder and Solow (11) is the use of proper measure of fiscal variable in Andersen and Jordan's reduced form equation. Blinder and Solow (11) compute the changes in the fiscal variable and define it as the change in the weighted standardized surplus.[7] They believe that using the change in the weighted full-employment surplus is not a good proxy for the change in the weighted standardized surplus (pp. 67-69). Therefore, this study uses a new measure of the fiscal influences on GNP which is akin to the weighted standardized deficit. This new measure of fiscal policy, TA is defined by Blinder and Goldfeld (37, p. 784) as

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[6]In Andersen and Jordan's (2) and Friedman and Meiselman's (31) studies, the annual and quarterly data adjusted for seasonal variations are used.

[7]The derivation for the change in weighted standardized surplus is shown in Appendix B.

TA = combined effect of current and past fiscal policies on real GNP of quarter (t), assuming that steady state is reached after two years.

This new measure of the fiscal policy will be examined by the Granger's (40) and Sims' (67) tests to determine whether it is exogenous in relation to change in GNP.

Section 3: Distributed Lags and Its Sensitivity in Andersen and Jordan's Study

Andersen and Jordan (2) apply the Almon distributed lag with a fourth degree polynomial to their single equation model. Consequently, a number of economists pose the question of whether application of the other distributed lag techniques can change the results of Andersen and Jordan's study. Therefore, in order to clarify this question further, this study employs four different distributed lag techniques, Almon, Koyck, Pascal, and rational, to determine whether the Andersen and Jordan technique is appropriate. Accordingly, the following sections provide the reader with a general review of these different distributed lag techniques and their applicabilities to this study.

The Structure of the Almon Polynomial Lag and Its Application

The structure of the fourth degree polynomial Almon lag with four lagged independent variables used by Andersen and Jordan (2) is formed as follows:

$$Y_t = \sum_{i=0}^{k} \beta_i X_{t-i} + \varepsilon_t \qquad (17)$$

where $k = 4$ and

$$\beta_i = (\alpha_0 + \alpha_1 i + \alpha_2 i^2 + \alpha_3 i^3 + \alpha_4 i^4) \qquad (18)$$

substituting β_i from (18) into the equation (17) will result in

$$Y_t = \sum_{i=0}^{4} (\alpha_0 + \alpha_1 i + \alpha_2 i^2 + \alpha_3 i^3 + \alpha_4 i^4) X_{t-i} \quad \text{or,}$$

$$Y_t = \alpha_0 Z_{0t} + \alpha_1 Z_{1t} + \alpha_2 Z_{2t} + \alpha_3 Z_{3t} + \alpha_4 Z_{4t} \tag{19}$$

where $Z_{0t} = \sum_{i=0}^{3} X_{t-i}$,

$$Z_{1t} = \sum_{i=0}^{3} i X_{t-i},$$

$$Z_{2t} = \sum_{i=0}^{3} i^2 X_{t-i},$$

$$Z_{3t} = \sum_{i=0}^{3} i^3 X_{t-i}, \text{ and}$$

$$Z_{4t} = \sum_{i=0}^{3} i^4 X_{t-i} \quad .$$

The α's are obtained by regressing Y_t on the constructed variables Z_{0t}, Z_{1t}, Z_{2t}, Z_{3t}, and Z_{4t}. Therefore, from equation (18) the values of β's can be obtained.

In order to apply this technique directly on Andersen and Jordan's reduced form equation, X should be defined as the matrix of independent variables (change in monetary variable and change in fiscal variable). Thus, one should construct the Almon polynomial lag for each independent variable and estimate regression

$$\Delta Y_t = \sum_{i=0}^{4} \beta_i \Delta M_{t-i} + \sum_{i=0}^{4} \gamma_i \Delta F_{t-i} + \varepsilon_t$$

where ΔM_t = the change in monetary variable,

ΔF_t = the change in fiscal variable,

ΔY_t = the change in GNP, and

ε_t = the disturbance term with mean zero and variance σ^2.

Pascal Distributed Lag and Its Application

The alternative distributed lag technique which is applied to Andersen and Jordan's reduced form equation is Pascal distributed lags of order 1 (r = 1) and order 2 (r = 2). Solow (68) has suggested the Pascal technique as

$$Y_t = \sum_{i=0}^{\infty} \beta_i X_{t-i} + u_t$$

where $\beta_i = \beta\binom{r+i-1}{i}(1 - \lambda)^r \lambda^i$,

$E(u_t) = 0$, and

$Var(u_y) = \sigma^2$

It can also be written in the form of

$$\beta_i = \beta[(i+r-1)! \;/\; i!(r-1)!](1-\lambda)^r \lambda^i$$

where r is some positive integer and $0 < \lambda < 1$, a parameter to be estimated. If r=1, the Pascal distributed lag reduces to a geometric lag distribution. In this study the two most common values of r=1 and r=2 are considered for applying Pascal distributed lag to the Andersen and Jordan's reduced form equation.

Pascal Distributed Lag with r=1 (Koyck Distributed Lag). The application of the Koyck distributed lag to the Andersen and Jordan reduced form equation results in regression[8]

[8]For finding the sensitivity of different distributed lag techniques in Andersen and Jordan's (2) study, the definitions of monetary and fiscal variables given by them first are used and tested. Then, the new definitions of monetary and fiscal variables are introduced in Andersen and Jordan's reduced form equation.

$$\Delta Y_t = \beta_1 \left[\frac{(1-\lambda)}{(1-\lambda L)}\right] \Delta M_t + \beta_2 \left[\frac{(1-\lambda)}{(1-\lambda L)}\right] \Delta F_t + \varepsilon_t \quad ^{9}$$

where $0 < \lambda < 1$, and L is the lag operator. For estimating this model, one can transfer it into the autoregressive form

$$(1-\lambda L)\ \Delta Y_t = \beta_1(1-\lambda)\ \Delta M_t + \beta_2(1-\lambda)\ \Delta F_t + V_t \quad \text{or}$$

$$\Delta Y_t = \lambda \Delta Y_{t-1} + \beta_1(1-\lambda)\ \Delta M_t + \beta_2(1-\lambda)\ \Delta F_t + V_t \qquad (20)$$

where $V_t = (1-\Delta L)\ \varepsilon_t$.

Unless V_t is white noise, estimation of (20) by the OLS method leads to inconsistent estimates of parameters (54, p. 360). Application of the Godfrey (36) test will determine the order of the serial correlation in (20), and non-linear least squares can be used to correct it for serial correlation. Because the disturbance V_t is not independent of the regressors[10] the estimation of equation (20) by OLS does not result in consistent estimators of parameters; thus, one cannot use them as the initial value for the non-linear least squares procedures. Consequently, the initial values of parameters are estimated using instrumental variables.

Fuller (34, pp. 220-225; 429-447) has proposed a specific way of applying this technique (using instrumental variables) when the matrix of independent variables includes lagged dependent variables and the disturbances are serially correlated. According to him, one can construct instrumental variables for Y_{t-1} and Y_{t-2} in the regression

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[9]The lag parameters λ, for simplicity, is assumed the same for both variables ΔM_t and ΔF_t.

[10]There is a lagged dependent variable on the right side of the equation (20).

$$Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 Y_{t-1} + \alpha_3 Y_{t-2} + V_t$$

in two steps: First to regress Y_{t-1} and Y_{t-2} on X_t, X_{t-1}, X_{t-2}, and a constant term, then to use the predicted values of $\hat{Y}_{t-1}$ and $\hat{Y}_{t-2}$ obtained from those regressions as the instrumental variables for Y_{t-1} and Y_{t-2}. Therefore, the application of OLS on the regression

$$Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 \hat{Y}_{t-1} + \alpha_3 \hat{Y}_{t-2} + U_t$$

will result in consistent estimators of α's. Additionally, Fuller (34) has proposed a solution to find the consistent estimates of ρ's, the autocorrelation coefficients of disturbances. He suggests estimating $\hat{V}_t$ from

$$\hat{V}_t = Y_t - \hat{\alpha}_0 - \hat{\alpha}_1 X_t - \hat{\alpha}_2 Y_{t-1} - \hat{\alpha}_3 Y_{t-2}$$

where $\hat{\alpha}_0$, $\hat{\alpha}_1$, $\hat{\alpha}_2$, and $\hat{\alpha}_3$ are the estimates of the parameters of regression

$$Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 \hat{Y}_{t-1} + \alpha_3 \hat{Y}_{t-2} + U_t$$

inally, the coefficients of regression $\hat{V}_t$ on lagged values of itself represent the consistent initial values of ρ's for the non-linear least square procedure.

Pascal Distributed Lag with r=2. The application of this type of distributed lag on the Andersen and Jordan reduced form equation results in regression

$$\Delta Y_t = \beta_1 \left[\frac{(1-\lambda)^2}{(1-\lambda L)^2}\right] \Delta M_t + \beta_2 \left[\frac{(1-\lambda)^2}{(1-\lambda L)^2}\right] \Delta F_t + \varepsilon_t,$$

where $0 < \lambda < 1$ and L is the lag operator. The autoregressive form of this model,

$$\Delta Y_t = 2\lambda\Delta Y_{t-1} - \lambda^2 Y_{t-2} + \beta_1(1-\lambda)^2\ \Delta M_t + \beta_2(1-\lambda)^2\ \Delta F_t + (1-\lambda L)^2\ \varepsilon_t \tag{21}$$

is used to estimate the parameters, λ and β's. After the order of serial correlation is determined by the Godfrey test, the non-linear least squares and instrumental variables techniques are applied to equation (21) to estimate the parameters, λ and β's.

Rational Distributed Lag and Its Application

Jorgenson (47) defines the rational distributed lag as the ratio of two polynomials $\frac{A(L)}{B(L)}$ in the lag operator L. This type of lag is applied to the Andersen and Jordan reduced form equation and thus results in estimating the regression

$$\Delta Y_t = \left[\frac{A(L)}{B(L)}\right] \Delta M_t + \left[\frac{C(L)}{D(L)}\right] \Delta F_t + \varepsilon_t \tag{22}$$

where A(L), B(L), C(L), and C(L) are finite.
In contrast to the other aforementioned types of distributed lags, the rational distributed lag is estimated using Box and Jenkins (42) transfer function.

Box and Jenkins Transfer Function and Its Application.

The rational distributed lag which is applied to the Andersen and Jordan reduced form equation can be formulated as

$$\Delta GNP = V(L)\Delta M_t + W(L)\Delta F_t + \varepsilon_t \tag{23}$$

where $V(L) = (v_0 + v_1 L + v_2 L^2 + \dots) = A(L) / B(L)$ and
$W(L) = (w_0 + w_1 L + w_2 L^2 + \dots) = C(L) / D(L)$.

Because the values for the v's and w's explain the changes in GNP resulting from a "one-time-only unit" changes in monetary and fiscal variables, they are called impulse response coefficients (12, p. 338). The polynomial operators V(L) and W(L) represent the transfer function relating change in GNP to monetary and fiscal variables. The two polynomial operations V(L) and W(L) can take any form. Thus, as a case in point, many alternative effects of lagged monetary and fiscal variables can be accommodated. The Box and Jenkins transfer function analysis basically consists of procedures for assessing which of the many alternative responses is in fact the correct one.

The polynomial operators V(L) and W(L) can be approximated as a ratio of two polynomials of lower order. The general forms of these polynomials of lower orders which are estimated in this study are

$$V(L) = \frac{A(L)}{B(L)} L^b \tag{24}$$

$$W(L) = \frac{C(L)}{D(L)} L^d \tag{25}$$

where L^b and L^d are the "dead time" operators representing the number of periods before any effect is discernible. The polynomial operators in the numerators of the equations (24) and (25) describe the size of the more immediate effects of the monetary and fiscal variables, whereas B(L) and D(L) describe "the duration and pattern of their decay" (42, p. 228). The equation (25) then can be re-written as

$$\Delta GNP = \frac{A(L)}{B(L)} L^b \Delta M_t + \frac{C(L)}{D(L)} L^d \Delta F_t + \varepsilon_t \tag{26}$$

In this regression, ε_t (the disturbances) which Box and Jenkins (12) call the noise function, is modeled as an ARMA (autoregressive-moving average process). For estimating equation (26) by Box and Jenkins transfer function method, the following steps are taken.

Step 1. Box and Jenkins analysis requires that all input and output series first be "prewhitened"; that is all "systematic" components from the series are removed (42, p. 229). Consequently, Box and Jenkins (12) univariate analysis is used to identify the type of ARIMA (integrated autoregressive-moving average process) model in each series (GNP, monetary, and fiscal variables). The bases for model choice are the autocorrelation and partial autocorrelation functions. The empirical patterns of autocorrelation and partial autocorrelation functions are compared with alternative theoretical forms and the form giving the closest resemblence is chosen.

Step 2. In this step equation (26) is identified by using the Box and Jenkins (12) multivariate technique and the prewhitened series obtained from the first step. The correlation coefficients between the prewhitened input series k period lag and the change in current output series is taken as direct estimate of the v_k and w_k, the impulse response coefficient at lag k. Subsequently, the order and the initial values of parameters in the polynomial and "dead time" operators, in equation (26), are estimated by comparing the patterns of the estimated impulse response coefficients with the alternative theoretical forms (p. 349).

Step 3. A last identification decision is whether to include a constant term in the equation (26). A natural preliminary estimate of this constant is the mean of the noise function (42, p. 234). Because the estimated means of the noise function obtained from Step 2 are statistically non-significant, a constant is omitted and equation (26) is used in the final step of analysis.

Step 4. The immediate effects of the monetary and fiscal variables, and the duration and pattern of their decay are observed from the direct estimates of equation (26) by using the Box and Jenkins (12) multivariate estimation technique. In this step, the determined order of polynomial and "dead time" operators and the observed initial values of the parameters in polynomial operators from the third step are used to estimate the equation (26). Moreover, the noise function for this equation, in the third step, is found and modeled as autoregressive process of order 1. Finally, if the identification and estimation procedures are taken correctly and properly, one should expect that the disturbances (noise function) in Step 4 are white noise.

CHAPTER IV

FINDINGS AND RESULTS

Friedman and Meiselman and Their Critics

Table II shows the results of the two tests of causality (Granger's and Sims' tests) as they are applied to the definitions of autonomous expenditures, monetary variables, and their components, given by Friedman and Meiselman (31) and by their critics. These empirical results neither support Friedman and Meiselman's definition of exogenous real and monetary variables, nor the other definitions cited by Friedman and Meiselman's critics. According to the outcomes of these two tests of causality in Table II, the definitions of autonomous expenditures and monetary variables given by Friedman and Meiselman and their critics are endogenous by both tests.[1] Consequently, the results of studies by Friedman and Meiselman and by their critics, because of using the endogenous variables in the right side of their single equation models, are not reliable and consistent. In order to have better and more reliable results, one should exclude the endogenous components from the autonomous expenditures and monetary variables defined by Friedman and Meiselman and by their critics. But, the results indicate that these two tests have not resulted in generally agreed upon exogeneity

[1] M*, the definition of exogenous monetary variable given by Ando and Modigliani (6), due to the unavailability of data, is not tested in this study.

TABLE II

TESTS OF CAUSALITY FOR COMPONENTS OF AUTONOMOUS EXPENDITURE AND MONETARY VARIABLES ANNUAL DATA 1929 - 1977 (FRIEDMAN AND MEISELMAN AND THEIR CRITICS)

Variables	Granger's Test: Value Of F Statistics	Granger's Test: Results	Sim's Test: Value Of F Statistics	Sim's Test: Results
D	3.94*	endogenous	26.84*	endogenous
ES	2.77*	endogenous	5.10*	endogenous[a]
F	1.43	exogenous	.98	exogenous[a]
G_1 G	.64	exogenous	3.22	exogenous
G_1 I	17.12*	endogenous	24.74*	endogenous[a]
G_2 I	.27	exogenous	60.20*	endogenous
G_1 P	2.97*	endogenous	.44	exogenous[a]
G_2 P	1.96	exogenous	3.10	exogenous
G_1 S	2.42	exogenous	5.10*	endogenous[a]
G_2 S	4.22*	endogenous	3.72*	endogenous[a]
G_1 T	2.85*	endogenous	13.60*	endogenous
G_2 T	1.37	exogenous	7.68*	endogenous
Id	5.06*	endogenous	.03	exogenous[aa]
If	.10	exogenous[a]	1.60	exogenous[a]
Im	6.22*	endogenous	22.64*	endogenous
Nc	3.29*	endogenous	—	inconclusive[aaa]
Rc	6.41*	endogenous	4.12*	endogenous
T_1 A	2.14	exogenous[aa]	9.52*	endogenous
T_2 A	3.36*	endogenous	7.84*	endogenous
T_1 B	.31	exogenous	1.68	exogenous[a]

TABLE II (Continued)

Variables	Granger's Test: Value Of F Statistics	Granger's Test: Results	Sim's Test: Value Of F Statistics	Sim's Test: Results
T_2B	.66	exogenous	3.04	exogenous
T_1C	5.40*	endogenous	1.26	exogenous[a]
T_2C	2.77*	endogenous[aaa]	7.28*	endogenous
T_1Y	10.50*	endogenous	49.72*	endogenous
T_2Y	1.96	exogenous	2.62	exogenous
CP	6.60*	endogenous	1.09	exogenous[a]
DD	3.79*	endogenous	3.92*	endogenous[a]
TD	1.10	exogenous	2.10	exogenous
SB	2.02	exogenous	2.60	exogenous
M_2	3.47*	endogenous	5.70*	endogenous
M_1	3.02*	endogenous	2.17	exogenous[a]
A_1	1.38	exogenous	2.69	exogenous
A_2	1.39	exogenous	1.33	exogenous
A	7.23*	endogenous	18.70*	endogenous[aa]
L	4.52*	endogenous	6.55*	endogenous
L'	4.30*	endogenous	6.20*	endogenous
L''	4.12*	endogenous	5.72*	endogenous[a]
L'''	3.75*	endogenous	5.75*	endogenous[aa]
H	3.41*	endogenous	13.75*	endogenous

*The value of F-statistics is significant at 5%.

Note: The definition of variables are given in Appendix A.

[a]The residuals of restricted regression failed to be stationary after attempting to correct them up to the fourth order of serial correlation.

TABLE II (Continued)

[aa]The residuals of both unrestricted and restricted regressions failed to be stationary after attempting to correct them up to the fourth order of serial correlation.

[aaa]The residuals of both restricted and unrestricted regressions failed to be stationary after attempting to correct them up to the fifth order of serial correlation.

of some variables such as G_1S, G_2T, and G_2I. It can be because of two reasons: first, the slight differences which exist in formulating the Granger's and Sims' tests of causality and secondly, failure to correct the disturbances of some of the regressions for serial correlation. Therefore, this study has accepted the results of the test of causality for which the residuals of regressions are successfully corrected for serial correlation. Moreover, the direction of causality is assumed to be inconclusive when the two tests have not resulted in generally agreed upon exogeneity of some variables and regressions are properly corrected for serial correlation. Thus, it is believed that the conflict is attributed to the slight differences in formulating the two tests of causality, as the case for G_2T and G_2I. Consequently, although G_1S, G_2T, G_2I are endogenous in Sims' test, this study suggests two new definitions of autonomous expenditures, A_1 and A_2, which are exogenous in relation to the consumption expenditure by both tests. A_1 and A_2, with the exceptions of G_2T and G_2I, are defined as the sum of all exogenous components of autonomous expenditure given by Friedman and Meiselman (31) and by their critics as follows:

$$A_1 = T_2Y + T_1B + T_2B + G_2P + G_1G + G_1S + I_f + F$$

$$A_2 = A_1 + G_2T + G_2I.$$

Moreover, the results of applying the two tests of causality to money supply, monetary base, and their components indicate that only time deposit and source base can be called exogenous. Therefore, in addition to time deposits, this paper studies and compares the relative role of source base, as the exogenous monetary variable, to the exogenous autonomous expenditures A_1 and A_2 in affecting consumption expenditures.

Table III shows the regression and the correlation coefficients between the consumption expenditure (C) and the defined measures of autonomous expenditures and exogenous monetary variables.[2] In contrast to Friedman and Meiselman's (31) conclusion that autonomous expenditures usually have low and insignificant regression coefficients, this table indicates, instead, significant regression and correlation coefficients for autonomous expenditures. Furthermore, excluding the Great Depression period from the data reduces the size of the regression coefficient for monetary variables rather than increasing it as Friedman and Meiselman have found. This table also indicates that performance of the two autonomous expenditures are approximately the same.[3] The quarterly and annual figures, in Table III, for monetary variables do not support either the Friedman and Meiselman conclusion that monetary

[2]In simple regression, beta coefficient is identical to the correlation coefficient (29, p. 119).

[3]Beta coefficients (simple correlation coefficients) are approximately the same.

TABLE III

SIMPLE REGRESSION EQUATIONS BETWEEN CONSUMPTION AND SYNCHRONOUS VALUES OF AUTONOMOUS EXPENDITURES AND EXOGENOUS MONETARY VARIABLES (1)

Period	$C = a_1 + b_1A_1$		$C = a_2 + b_2A_2$		$C = a_3 + b_3TD$		$C = a_4 + b_4SB$	
	b_1	r_{CA_1}	b_2	r_{CA_2}	b_3	r_{TD}	b_4	r_{SB}
Annual Figures								
1929 - 1977 including 1941 - 1945	1.96 (25.79)	.995	2.05 (26.20)	.995	2.19 (15.19)	.989	10.86 (13.76)	.956
1929 - 1977 excluding 1941 - 1945	1.97 (25.65)	.995	2.06 (25.75)	.995	2.25 (26.10)	.989	6.76 (5.99)	.955
1929 - 1958 including 1941 - 1945	0.65 (5.42)	.979	0.66 (5.50)	.978	2.79 (3.30)	.986	2.40 (2.21)	.910
1929 - 1958 excluding 1941 - 1945	1.55 (3.06)	.983	3.01 (14.76)	.982	3.34 (6.43)	.988	1.75* (7.10)	.925
1938 - 1958 including 1941-1945	1.80 (4.18)	.976	0.64* (4.80)	.978	2.67 (3.11)	.988	0.43 (0.49)	.915
1959 - 1977	2.02 (9.90)	.997	2.12 (8.52)	.997	2.34 (75.30)	.998	11.69 (13.15)	.996

TABLE III (Continued)

Period	$C = a_1 + b_1A_1$		$C = a_2 + b_2A_2$		$C = a_3 + b_3TD$		$C = a_4 + b_4SB$	
	b_1	r_{CA}	b_2	r_{CA_2}	b_3	r_{TD}	b_4	r_{SB}
<u>Quarterly Figures</u>								
1946_{I} - 1958_{IV}	-0.16 (0.88)	.947	-0.15 (0.83)	.943	0.68 (0.56)	.938	0.92 (0.82)	.843
1959_{I} - 1977_{IV}	1.85 (42.04)	.994	1.94 (44.10)	.994	2.33 (58.20)	.996	9.17 (6.37)	.995
1946_{I} - 1977_{IV}	1.85 (66.10)	.996	1.92 (66.20)	.996	2.34 (41.80)	.997	9.12 (6.80)	.989

[1]The residuals of regressions are corrected for serial correlation, using non-linear least squares techniques and Cochrane-Orcutt procedure. Moreover, the t-ratios are given in parentheses.

*The residuals of this regression, after correction for the first, second, and third order of serial correlations, using non-linear least squares techniques, have failed to be stationary.

variables are more significantly correlated with consumption than consumption with autonomous expenditures; that is, the correlation coefficients reported for autonomous expenditures and monetary variables in this table are approximately equal.

Tables IV and V show the results of the multiple regression of C on A_1 and A_2 and Td or SB. These results, in contrast to Friedman and Meiselman's (31) conclusion, suggest significant regression coefficients for the autonomous expenditures. Additionally, Table IV indicates, with the exception for quarterly data, greater beta coefficients for A_1 and A_2 than for SB. On the other hand, Table V shows the fact that the monetary variable (TD) has greater beta coefficients than the two autonomous expenditures and can, thus, explain a larger portion of the variance in C, especially in some of the sub-periods of 1929-1977. The partial correlation coefficients in Table VI also indicate that A_1 and A_2 explain a larger portion of the variance in C than SB, except for the period of 1946_{I}-1977_{IV}. Moreover, this table shows higher partial correlation coefficients for TD than for the two autonomous expenditures during the 1929-1958 (including war years), 1938-1958, 1959_{I}-1977_{IV}, and 1946_{I}-1977_{IV} periods of data; that is, TD as an exogenous monetary variable performs better than SB in explaining the variance in C.

Tables VII and VIII show the simple and multiple regressions of the change in C on the change in A_1 or A_2 and the change in SB or TD. In contrast to Friedman and Meiselman's (31) results, these two tables show a negative and insignificant regression coefficient for ΔTD; but a positive and insignificant one for ΔSB during the period of 1946_{I}-1958_{IV}. On the other hand, the results for the period of data after 1958 indicate that the first differences of TD and SB are positively

TABLE IV

MULTIPLE REGRESSION EQUATIONS OF CONSUMPTION ON AUTONOMOUS EXPENDITURES AND EXOGENOUS MONETARY VARIABLES[1]

Period	$C = a_1 + b_1A_1 + c_1SB$					$C = a_2 + b_2A_2 + c_2SB$				
	b_1	β_{A_1}	c_1	β_{SB}	r	b_2	β_{A_2}	c_2	β_{SB}	r
Annual Figures										
1929-1977 including 1941-1945	1.440 (12.580)	.724	3.450 (4.220)	.350	.998	1.520 (12.660)	.730	3.310 (4.020)	.335	.998
1929-1977 excluding 1941-1945	1.580 (19.130)	.796	2.480 (5.660)	.255	.998	1.660 (19.310)	.803	2.420 (5.590)	.248	.998
1929-1958 including 1941-1945	1.520 (6.910)	.490	2.613 (4.100)	.567	.991	1.500 (6.520)	.460	2.640 (3.880)	.573	.991
1929-1958 excluding 1941-1945	1.697 (8.700)	.540	2.174 (6.590)	.480	.992	1.220 (4.570)	.370	1.990 (6.320)	.440	.993
1938-1958 including 1941-1945	2.080 (16.100)	.703	1.710 (7.720)	.340	.991	2.270 (15.900)	.705	1.710 (7.480)	.340	.990
1959-1977	1.190 (2.700)	.630	5.900 (2.810)	.520	.997	1.176* (9.120)	.598	4.735* (7.540)	.420	.997

TABLE IV (Continued)

Period	$C = a_1 + b_1A_1 + c_1SB$					$C = a_2 + b_2A_2 + c_2SB$				
	b_1	βA_1	c_1	β_{SB}	r	b_2	βA_2	c_2	β_{SB}	r
<u>Quarterly Figures</u>										
1946_{I}-1958_{IV}	-.170	-.070	1.003	.056	.968	-.167	-.067	1.010	.056	.965
	(-.890)		(.890)			(-.898)		(.898)		
1959_{I}-1977_{IV}	-.010	-.005	9.860	.960	.996	-.010	-.005	9.820	.956	.996
	(-.250)		(6.010)			(-.250)		(5.990)		
1946_{I}-1977_{IV}	-.031	-.016	.726	.050	.997	-.030	-.020	.730	.050	.997
	(-.670)		(.896)			(-.650)		(.900)		

[1]t-ratios are shown in parentheses.

*The residuals of this regression, after correction for the first, second, and third order of serial correlation, have failed to be stationary.

TABLE V

MULTIPLE REGRESSION EQUATIONS OF CONSUMPTION ON AUTONOMOUS EXPENDITURES AND EXOGENOUS MONETARY VARIABLES[1]

Period	$C = a_1 + b_1A_1 + c_1TD$					$C = a_2 + b_2A_2 + c_2TD$				
	b_1	β_{A_1}	c_1	β_{TD}	r	b_2	β_{A_2}	c_2	β_{TD}	r
Annual Figures										
1929-1977 including 1941-1945	.660	.332	1.450	.545	.995	.745	.360	1.410	.530	.995
	(4.710)		(9.100)			(5.250)		(9.100)		
1929-1977 excluding 1941-1945	.581	.293	1.640	.620	.995	.642	.310	1.600	.605	.995
	(3.230)		(8.410)			(3.450)		(8.250)		
1929-1958 including 1941-1945	.720*	.233	1.460*	.270	.991	.730*	.225	1.460*	.270	.991
	(3.670)		(2.800)			(3.730)		(2.810)		
1929-1958 excluding 1941-1945	.740	.235	3.060	.550	.993	.760	.230	3.050	.550	.993
	(2.900)		(6.950)			(2.980)		(7.020)		
1938-1958 including 1941-1945	.730	.240	1.650	.330	.991	.720	.220	1.590	.680	.990
	(3.590)		(2.270)			(3.610)		(2.090)		
1959-1977	.560	.297	1.670	.715	.999	.660	.330	1.590	.680	.999
	(2.290)		(6.010)			(2.480)		(5.640)		

TABLE V (Continued)

Period	$C = a_1 + b_1A_1 + c_1TD$					$C = a_2 + b_2A_2 + c_2TD$				
	b_1	β_{A_1}	c_1	β_{TD}	r	b_2	β_{A_2}	c_2	β_{TD}	r
Quarterly Figures										
1946_I-1958_{IV}	-.160	-.067	.698	.140	.959	-.150	-.060	.690	.140	.958
	(-.860)		(.560)			(-.810)		(.560)		
1959_I-1977_{IV}	.020	.011	2.310	.989	.999	.020	.010	2.310	.989	.999
	(.400)		(38.500)			(.420)		(36.100)		
1946_I-1977_{IV}	.012	.006	2.320	.952	.998	.011	.006	2.320	.952	.998
	(.240)		(29.790)			(.220)		(30.300)		

[1] t-ratios are shown in parentheses.

*Residuals have failed to be stationary.

TABLE VI

PARTIAL CORRELATION COEFFICIENTS

Period	$r_{CA_1.SB}$	$r_{CA_2.SB}$	$r_{CA_1.TD}$	$r_{CA_2.TD}$	$r_{CSB.A_1}$	$r_{CSB.A_2}$	$r_{CTD.A_1}$	$r_{CTD.A_2}$
Annual Figures								
1929-1977 including 1941-1945	.936	.982	.375	.375	.681	.280	.235	.230
1929-1977 excluding 1941-1945	.980	.980	.753	.753	.810	.810	-.230	-.230
1929-1958 including 1941-1945	.941	.954	.557	.532	.725	.782	.734	.740
1929-1958 excluding 1941-1945	.909	.903	.928	.917	.504	.500	.773	.772
1938-1958 including 1941-1945	.975	.986	.464	.436	.912	.953	.799	.801
1959-1977	.869	.869	.999	.999	.822	.822	.999	.999
Quarterly Figures								
1946_{I}-1958_{IV}	.885	.873	.586	.555	.625	.617	.485	.499

TABLE VI (Continued)

Period	$r_{CA_1.SB}$	$r_{CA_2.SB}$	$r_{CA_1.TD}$	$r_{CA_2.TD}$	$r_{CSB.A_1}$	$r_{CSB.A_2}$	$r_{CTD.A_1}$	$r_{CTD.A_2}$
1959_{I}-1977_{IV}	.675	.675	.632	.632	.620	.620	.774	.774
1946_{I}-1977_{IV}	.574	.574	.821	.821	.940	.940	.870	.870

TABLE VII

SIMPLE REGRESSION EQUATIONS OF FIRST DIFFERENCES OF CONSUMPTION ON FIRST DIFFERENCES OF AUTONOMOUS EXPENDITURES OR THE EXOGENOUS MONETARY VARIABLES (QUARTERLY FIGURES)

Dependent Variable	Regression Coefficient of (and its t-ratio)				
	ΔSB	ΔTD	ΔA_1	ΔA_2	r
1946_I-1958_{IV}					
ΔC_t			-.136 (-.660)		.151
ΔC_t				-.128 (-.621)	.145
ΔC_t	.896 (.900)				.131
ΔC_t		-.756 (-.850)			.027
1959_I-1977_{IV}					
ΔC_t			-.034 (-1.096)		.118
ΔC_t				-.034 (-1.095)	.112
ΔC_t	4.159 (2.498)				.711
ΔC_t		1.689 (7.126)			.799
1946_I-1977_{IV}					
ΔC_t			-.040 (-.869)		.168
ΔC_t				-.040 (-.858)	.161
ΔC_t	7.011 (7.685)				.633
ΔC_t		1.914 (13.130)			.761

TABLE VIII

MUTLIPLE REGRESSION EQUATIONS OF FIRST DIFFERENCES OF CONSUMPTION ON FIRST DIFFERENCES OF AUTONOMOUS EXPENDITURES OR THE EXOGENOUS MONETARY VARIABLES (QUARTERLY FIGURES)

Dependent Variable	Regression Coefficient of (and its t-ratio)				
	ΔSB	ΔTD	ΔA_1	ΔA_2	r
1946_{I}-1958_{IV}					
ΔC_t	.980 (.930)		-.150 (-.710)		.210
ΔC_t	.998 (.950)			-.140 (-.660)	.205
ΔC_t		-.710 (-.760)	-.110 (-.520)		.153
ΔC_t		-.720 (-.770)		-.100 (-.480)	.147
1959_{I}-1977_{IV}					
ΔC_t	3.77 (2.23)		-.029 (-.880)		.711
ΔC_t	3.780 (2.240)			-.028 (-.866)	.711
ΔC_t		1.674 (6.830)	-.031 (-.126)		.799
ΔC_t		1.674 (6.833)		-.031 (-.880)	.799
1946_{I}-1977_{IV}					
ΔC_t	7.011 (7.621)		.002 (.038)		.655
ΔC_t	7.011 (7.630)			.001 (.020)	.654
ΔC_t		1.921 (12.760)	-.010 (-.200)		.761
ΔC_t		1.920 (12.790)		-.010 (-.210)	.761

and significantly correlated to the first difference of consumption expenditure. Moreover, Table VII shows that ΔTD and ΔSB have greater correlation coefficients with ΔC than ΔC has with either A_1 or A_2 after 1958; that is, change in monetary variable can explain the variance of the change in consumption expenditure better than the change in autonomous expenditures.

In summary, while the above findings generally support Friedman and Meiselman's (31) critics, who state that autonomous expenditures explain the variance of consumption expenditures at least as effectively as the monetary variables before 1958, they indicate that the relative importance of real and monetary variables is indeterminate. It depends upon the definition of monetary variable, the use of quarterly or annual data, and the time period.

Andersen and Jordan and Their Critics

The results of the Granger's (40) and Sims' (67) tests of causality in Table IX indicate that, with the exceptions of monetary base (MB), free reserves (FR), unborrowed reserves (UR), and weighted standardized deficit (TA), the definitions of monetary and fiscal variables given by Andersen and Jordan (2) and by their critics are not exogenous. Moreover, this table shows that the results of the aforementioned tests of causality have not resulted in agreed upon exogeneity of monetary base. According to the Sims' test of causality, MB is strictly exogenous (this result is the same as what Mehra (57) has found in his study), while the oucome of the Granger test indicates that MB is endogenous. This conflicting result, which is explained in previous pages, may be due to the slight differences which exist in formulating the Granger's and Sims' tests of causality. However, one can allude

TABLE IX

TEST OF CAUSALITY FOR COMPONENTS OF FISCAL AND MONETARY VARIABLES IN ANDERSEN AND JORDAN'S STUDY

Variables	Granger's Test: Value of F Statistics	Granger's Test: Results	Sim's Test: Value of F Statistics	Sim's Test: Results
Quarterely Data 1952_{I}-1978_{IV}				
CP	9.93*	endogenous	6.52*	endogenous
BR	2.93*	endogenous	3.03*	endogenous
FR	2.18	exogenous	2.46	exogenous
M_1	3.27*	endogenous	2.78*	endogenous
M_2	3.01*	endogenous	2.95*	endogenous
S	4.33*	endogenous	4.91*	endogenous[a]
R	7.38*	endogenous	18.47*	endogenous
E	3.95*	endogenous	2.95*	endogenous
MB	2.85*	endogenous	.92	exogenous
Data 1949_{I}-1978_{IV}				
RN	6.71*	endogenous	5.19*	endogenous
Data 1959_{I}-1978_{IV}				
TA	.45	exogenous	1.83	exogenous
Data 1959_{I}-1978_{IV}				
UR	.655	exogenous	.14	exogenous[aa]

[a]Residuals of restricted regression failed to be stationary.

[aa]Residuals of restricted and unrestricted regressions failed to be stationary.

*The value of F-statistic is significant at 5%.

to the fact that, because free reserves and unborrowed reserves are strictly exogenous, they should be represented as the measure of monetary variables in Andersen and Jordan's (2) reduced form equation. But although they are statistically exogenous, it is questioned, by Andersen and Jordan (3) and by Meigs (58), whether free reserves and unborrowed reserves can economically be a good measure of monetary variables in determining the changes in GNP. Meigs points out:

> If an increase in the free reserve level is to be interpreted as an easing in the restrictiveness of monetary policy, it ought to induce an increase in the rate of growth of member-bank deposits. Actually, however, an increase in the free reserve level may occur with a reduction in the rate of growth of deposits under certain conditions. Efforts of banks to increase the free reserve level may show the rate of growth of deposits or bring about a contraction, as the banks sell assets in order to build up excess reserves and to pay off borrowings at the Federal Reserve (p. 4).

The wrong signs for regression coefficients of free reserves in Tables XV-XVIII of this study are possibly supportive of the aforementioned Meig's argument. More specifically, Meigs (58, p. 2) believes that using total member bank reserves as a proximate goal for open-market operations can more precisely control the expansion or contraction of bank deposits than the use of free reserve. His empirical study supports the hypothesis that "the rate of change of deposits is not closely related to the level of free reserves" (p. 2). Meigs finally concludes that operations may be questioned on the grounds that:

> Although open-market operations do influence the free reserves of the member banks, free reserves in the postwar period examined in this study have been influenced more by movements of interest rates than by open-market operation . . . and there is no one actual volume of free reserves associated with a particular rate of deposit expansion (pp. 87-88).

Consequently, in spite of the fact that free reserves, FR, is statistically exogenous, it cannot theoretically represent a good proxy for measuring the monetary influences on GNP.

Andersen and Jordan (3), on the other hand, believe that unborrowed reserves cannot economically be a good measure of monetary variables in determining the change in GNP. They argue that theoretically "if there is an offset between unborrowed reserves and borrowed reserves, the borrowing should not be excluded from the base" (p. 15). In the regression of ΔR_u (change in unborrowed reserves) on ΔR_b (change in borrowed reserves), Andersen and Jordan find that ΔR_u and ΔR_b are negatively and significantly correlated. Consequently, they conclude that there is no justification for excluding borrowed reserves from the base and using unborrowed reserves as the measure of monetary influences on GNP (p. 15).[4] Therefore, because of the strong theoretical and empirical arguments made by Andersen and Jordan (3), which are supportive of using MB rather than unborrowed reserve, UR, as the measure of monetary variables and the outcome of Sims' test, which is in support of using MB as the exogenous monetary variable, monetary base is seen in this study as the appropriate measure of monetary influences on GNP.

Tables X-XIV of this study show the application of different distributed lag techniques to Andersen and Jordan's (2) reduced form equation, using data from the first quarter of 1952 through the second quarter of 1968. The results generally support Andersen and Jordan's main conclusion that changes in monetary variables have a great influence on change in GNP. The outcome of Koyck and Pascal

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[4]Andersen and Jordan's (3) questioning of the use of unborrowed reserves as a measure of monetary variable is stated in more detail in Section 2 of Chapter II, in response to DeLeeuw and Kalchbrenner's criticisms of Andersen and Jordan's technique.

TABLE X

KOYCK DISTRIBUTED LAG (1952_{I}-1968_{II})

First Differences	Equation 1 (λ = .45)		Equation 2 (λ = .38)		
	ΔMB	ΔS	ΔMB	ΔE	ΔR
t	7.41* (3.32)	.18 (.70)	6.54* (2.92)	.11 (.37)	.61** (1.79)
t-1	3.33	.08	2.48	.04	.23
t-2	1.50	.04	.94	.02	.09
t-3	.67	.02	.36	.01	.03
Sum	13.47	.33	10.55	.18	.98
S.E	4.96		4.86		
Constant	1.75** (1.66)		1.48 (1.42)		

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficient marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statistically significant at the 10% level. S.E is the standard error of the estimate.

Note 2: All regressions are corrected for serial correlation, using non-linear lease square procedure.

TABLE XI

PASCAL DISTRIBUTED LAG r=2 (1952_I-1968_{II})

First Differences	Equation 1 (λ = .501)		Equation 2 (λ = .491)		
	ΔMB	ΔS	ΔMB	ΔE	ΔR
t	7.06* (3.87)	.10 (.44)	6.43* (3.46)	.11 (.41)	.42 (1.39)
t-1	7.13	.10	6.13	.11	.41
t-2	5.4	.08	4.37	.08	.30
t-3	3.64	.05	2.86	.05	.20
Sum	28.82	.41	24.82	.42	1.61
S.E	4.88		4.82		
Constant	1.44** (1.83)		1.33** (1.68)		

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statistically significant at the 10% level. S.E is the standard error of the estimate.

Note 2: All regressions are corrected for serial correlation, using non-linear least square procedure.

TABLE XII

ALMON DISTRIBUTED LAG WITH FOURTH DEGREE POLYNOMIAL (1952_{I}-1968_{II})

First Differences	Equation 1		Equation 2		
	ΔMB	ΔS	ΔMB	ΔE	ΔR
t	2.224 (.665)	.409 (1.556)	1.235 (.357)	.137 (.371)	.724* (2.050)
t-1	9.52 (3.170)	-.157 (-.568)	7.383* (2.073)	.356 (1.060)	-.055 (-.150)
t-2	5.847* (1.973)	.157 (.568)	6.197** (1.855)	-.172 (-.542)	.177 (.474)
t-3	-.528 (-.160)	.210 (.774)	.216 (.062)	-.809* (-2.736)	-.155 (-.410)
Sum	17.060* (4.705)	.619 (.858)	15.031* (5.167)	-.489 (-.796)	.691 (.857)
S.E	4.705		4.723		
Constant	1.913 (1.237)		2.194** (1.791)		
D-W	1.910		1.670		

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statistically significant at the 10% level. S.E is the standard error of the estimate, and D-W is the Durbin-Watson statistic.

Note 2: The slight differences of these results from those of Andersen and Jordan (2) are persumably due to program and computer differences and data revisions.

TABLE XIII

RATIONAL DISTRIBUTED LAG (1952_{I}-1968_{II})

First Differences	Equation 1		Equation 2		
	ΔMB	ΔS	ΔMB	ΔE	ΔR
t	0	0	0	0	.830** (1.694)
t-1	0	-.440* (-2.39	0	0	-.190 (-.292)
t-2	0	-.403	0	-.042 (-.090)	0
t-3	8.627* (2.211)	-.369	6.886 (1.50)	-.020	0
t-4	-.783 (-1.775)	-.339	1.122 (.259)	.030	0
t-5	0	-.311	0	.002	0
Sum	7.844* (2.086)	-1.860	8.108 (1.252)	-.030	.640 (.691)
S.E	5.915		6.862		

Note 1: Constant terms are omitted from these equations, because the mean of the noise function which are a natural preliminary estimate of these constants are statistically insignificant (40, p. 234).

Note 2: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statistically significant at the 10% level. S.E is the standard error of the estimate.

Note 3: The estimated rational distributed lag of equations 1 and 2 are as follows:

$$\text{Equation 1:}\quad \Delta GNP=\underset{(2.21)}{(8.627}\ -\ \underset{(-1.78)}{.783L)}L^{3}\Delta MB\ -\ \underset{(-2.32)}{.439}\underset{(-11.46)}{(1\ -\ .917L)^{-1}}L\Delta S$$

TABLE XIII (Continued)

Equation 2:

$$\Delta GNP = \underset{(1.50)}{(6.886} + \underset{(.26)}{1.1224L})L^3 \Delta MB - \underset{(-.09)}{.0422}L^2(1 - \underset{(-.35)}{.3683}L + \underset{(.68)}{.771}L^2)^{-1} \Delta E + (\underset{(1.69)}{.8303} - \underset{(.29)}{.18977}L) \Delta R$$

where, L is lag operator and "t" values appear below each coefficient enclosed by paranthesis. Moreover, the ARMA forms of disturbance terms are found to be AR(1) and consequently, the regressions are corrected for the existed serial correlation.

TABLE XIV

MEASUREMENTS OF THE RELATIVE IMPORTANCE OF MONETARY AND FISCAL ACTIONS, BETA COEFFICIENTS (1952_{I}-1968_{II})

	Equation 1		Equation 2		
Quarters	ΔMB	ΔS	ΔMB	ΔE	ΔR
Almon Distributed Lag					
t	.11	.16	.06	.05	.21
t-1	.48	-.06	.37	.14	-.02
t-2	.29	.06	.31	-.07	.05
t-3	-.03	.08	.01	-.31	-.04
Sum	.85	.24	.75	-.19	.20
Koyck Distributed Lag					
t	.37	.07	.33	.04	.18
t-1	.17	.03	.12	.02	.07
t-2	.07	.02	.05	.01	.03
t-3	.03	.01	.02	.01	.01
Sum	.68	.13	.53	.07	.29
Pascal Distributed Lag (r=2)					
t	.35	.04	.32	.04	.12
t-1	.36	.04	.38	.04	.12
t-2	.27	.03	.30	.03	.09
t-3	.18	.02	.14	.02	.06
Sum	1.45	.16	1.24	.16	.47

TABLE XIV (Continued)

Quarters	Equation 1 ΔMB	Equation 1 ΔS	Equation 2 ΔMB	Equation 2 ΔE	Equation 2 ΔR
Rational Distributed Lag					
t	0	0	0	0	.25
t-1	0	-.17	0	0	-.06
t-2	0	-.15	0	-.02	0
t-3	.43	-.14	.35	-.01	0
t-4	-.04	-.13	.06	.01	0
t-5	0	-.12	0	.00	0
Sum	.39	-.71	.41	-.02	.19

distributed lags show small regression coefficients for fiscal variables with the wrong sign for ΔR, ΔS, and ΔE; but the regression coefficients for ΔMB are positive in sign and larger in magnitude. However, with the exception of the rational distributed lag for ΔS, the beta coefficients in Table XIV and the results in Tables X-XIII indicate that the application of the other types of distributed lags to Andersen and Jordan's reduced form equation are sufficiently similar to those obtained by Andersen and Jordan (2),[5] Mehra (57), and Elliott (24). Table XIV clearly shows that ΔS, as a measure of fiscal measure, performs much better than ΔMB when one uses rational distributed lag techniques. Thus, if Andersen and Jordan had used rational distributed lag rather than the Almon distributed lag in their study, they would not conclude that the response of change in GNP to fiscal variable is approximately zero.[6]

The results, reported in Tables XV-XIX, of re-estimating the St. Louis reduced form equation using the new measure of fiscal variable (weighted standardized deficit) are similar to what Andersen and Jordan (2) have found; that is, the monetary variable multipliers in all types of distributed lags are greater than the multiplier for fiscal variable, change in weighted standardized deficit (ΔTA). Table XIX indicates that the beta coefficients for change in monetary base are

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[5]The given t-statistics and beta coefficients for ΔMB shown in Tables X-XIV are generally, with a few exceptions, greater than those for ΔS, ΔE, and ΔR. Moreover, the beta coefficients for ΔMB drop sharper, within a few quarters, than those for ΔS, ΔE, and ΔR.

[6]Andersen and Jordan (2, p. 126) in their empirical study, conclude that sum of the beta coefficients for fiscal variables are virtually zero.

TABLE XV

KOYCK DISTRIBUTED LAG (1959_{IV}-1974_{II})

Quarters	Equation 1 (λ = .33) ΔMB	ΔTA	Equation 2 (λ = .78) ΔUR	ΔTA	Equation 3 (λ = .70) ΔFR	ΔTA
t	9.75* (4.58)	.36** (1.88)	-.92 (-.58)	.33 (1.53)	-5.98** (-1.74)	.34 (1.54)
t-1	3.22	.12	-.72	.26	-4.19	.24
t-2	1.06	.04	-.56	.20	-2.93	.17
t-3	.35	.01	-.44	.16	-2.05	.12
Sum	14.55	.54	-4.18	1.50	-19.93	1.13
Constant	.53 (.37)		3.12* (2.03)		3.86* (2.49)	
S.E	6.61		7.77		7.59	
R^2	.60		.44		.47	

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statistically significant at the 10% level. S.E is the standard error of the estimate.

Note 2: ΔTA is the change in weighted standardized deficits and therefore, positive regression coefficients are expected for this variable.

Note 3: All regressions are corrected for serial correlation, using non-linear least square technique.

TABLE XVI

PASCAL DISTRIBUTED LAG r=2 (1959_{IV}-1974_{II})

Quarters	Equation 1 (λ = .16) ΔMB	Equation 1 (λ = .16) ΔTA	Equation 2 (λ = .25) ΔUR	Equation 2 (λ = .25) ΔTA	Equation 3 (λ = .15) ΔFR	Equation 3 (λ = .15) ΔTA
t	9.46* (3.96)	.36** (1.79)	-1.24 (-.73)	.38 (1.59)	-8.91 (-2.01)	.46 (1.45)
t-1	3.03	.12	-.62	.19	-2.67	.14
t-2	.73	.03	-.23	.07	-.60	.03
t-3	.16	.01	-.08	.02	-.12	.01
Sum	13.42	.52	-2.20	.67	-12.33	.64
Constant	.73 (.48)		3.40* (1.96)		4.89* (2.33)	
S.E	6.72		7.65		7.46	
R^2	.58		.46		.50	

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statistically significant at the 10% level. S.E is the standard error of the estimate.

Note 2: ΔTA is the change in weighted standardized deficits and therefore, positive regression coefficients are expected for this variable.

Note 3: All regressions are corrected for serial correlation, using non-linear least squares technique.

TABLE XVII

ALMON DISTRIBUTED LAG (1959_{IV}-1974_{II})

Quarters	Equation 1		Equation 2		Equation 3	
	ΔMB	ΔTA	ΔUR	ΔTA	ΔFR	ΔTA
t	3.05 (.87)	.43 (1.08)	-.38 (-.12)	.26 (.44)	-15.53* (-3.57)	.38 (.79)
t-1	5.69 (1.49)	.07 (.14)	-.90 (-.29)	-.13 (-.20)	5.09 (1.10)	.15 (.31)
t-2	2.46 (.63)	-.18 (-.37)	1.63 (.55)	.12 (.21)	-11.08* (-2.48)	.42 (.84)
t-3	4.54 (1.22)	.22 (.55)	-.10 (-.03)	.54 (.83)	-4.89 (-1.02)	-.29 (-.58)
Sum	15.75* (7.76)	.54** (1.83)	.25 (.04)	.80 (1.19)	-26.41* (-2.31)	.65 (1.10)
Constant	.33 (.16)		14.93* (4.06)		14.24* (5.11)	
S.E	6.52		8.72		7.44	
R^2	.62		.32		.50	

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant at the 5% level. But those which are marked by "**" are statiscally significant at the 10% level. S.E is the standard error of the estimate.

Note 2: ΔTA is the change in weighted standardized deficits and therefore, positive regression coefficients are expected for this variable.

TABLE XVIII

RATIONAL DISTRIBUTED LAG (1959_{IV}-1974_{II})

Quarters	Equation 1		Equation 2		Equation 3	
	ΔMB	ΔTA	ΔUR	ΔTA	ΔFR	ΔTA
t	0	0	0	0	-.487 (-.247)	0
t-1	0	0	0	0	-4.632	0
t-2	0	0	0	0	-7.071	0
t-3	6.123 (1.512)	0	0	0	-6.590	0
t-4	6.329	0	0	0	-6.150	0
t-5	4.041	0	0	0	-5.731	0
t-6	1.598	.917	0	1.634* (2.760)	-5.323	1.623
t-7	.003	.336	0	.322	-4.942	.711
t-8	a	a	0	1.100	a	a
t-9	a	a	0	.420	a	a
t-10	a	a	15.796* (3.079)	.779	a	a
t-11	a	a	-.642 (-.921)	.420	a	a
t-12	a	a	.787 (.961)	.577	a	a
Sum	18.094	1.896	15.941	8.832	-66.222	4.143
S.E	6.751		9.801		9.620	

Note 1: Regression coefficients are the top figures, and their "t" values appear below each coefficient enclosed by parenthesis. The regression coefficients marked by "*" are statistically significant

TABLE XVIII (Continued)

at the 5% level and those marked by "a", due to the length of the lag and the size of coefficients which are approximately zero, the regression coefficients are not reported. S.E is the standard error of the estimate.

Note 2: The estimated rational distributed lag of equations 1, 2, and 3 are as follows:

Equation 1:
$$\Delta GNP = \underset{(4.13)}{6.123}L^3(1 - \underset{(-61.41)}{1.034}L + \underset{(.58)}{.408}L^2)^{-1}\,\Delta MB + \underset{(.45)}{.913}L^6(1 - \underset{(-.80)}{.369}L - \underset{(-.60)}{.190}L^2)^{-1}\Delta TA$$

Equation 2:
$$\Delta GNP = (\underset{(3.08)}{15.796} - \underset{(-.92)}{.642}L + \underset{(.96)}{.787}L^2)L^{10}\Delta UR + \underset{(2.76)}{1.634}L^6(1 - \underset{(-.80)}{.197}L - \underset{(-.64)}{.634}L^2)^{-1}\Delta TA$$

Equation 3:
$$\Delta GNP = (\underset{(-.25)}{-.487} - \underset{(-.22)}{4.176}L - \underset{(-.33)}{2.758}L^2)(1 - \underset{(-4.66)}{.932}L)^{-1}\Delta FR + \underset{(.25)}{1.623}L^6(1 - \underset{(-1.18)}{.436}L - \underset{(-.38)}{.195}L^2)^{-1}\Delta TA$$

where L is lag operator and "t" values appear below each coefficient enclosed by paranthesis. Moreover, the ARMA forms of disturbance terms for equation 1, 2, and 3, are found to be AR(0), AR(0), and AR(1), respectively.

TABLE XIX

MEASUREMENTS OF THE RELATIVE IMPORTANCE OF MONETARY AND FISCAL ACTIONS, BETA COEFFICIENTS
$(1959_{IV}-1974_{II})$

Quarters	Equation 1	
	ΔMB	ΔTA
Almon Distributed Lag		
t	.16	.16
t-1	.30	.03
t-2	.13	-.07
t-3	.24	.08
Sum	.83	.20
Koyck Distributed Lag		
t	.53	.13
t-1	.18	.04
t-2	.06	.02
t-3	.02	.01
Sum	.79	.20
Pascal Distributed Lat r=2		
t	.51	.13
t-1	.17	.04
t-2	.04	.02
t-3	.01	.00
Sum	.73	.19

TABLE XIX (Continued)

Quarters	Equation 1	
	ΔMB	ΔTA
Rational Distributed Lag		
t-3	.33	0
t-4	.34	0
t-5	.22	0
t-6	.09	.33
t-7	.00	.12
Sum	.98	.69

much greater than those for ΔTA. Moreover, beta coefficients for ΔMB drop more sharply, generally, than the beta coefficients for ΔTA. The Almon distributed lag results are the exception. Table XV-XIX also suggest that the response of change in GNP to fiscal variable is considerably greater than zero.[7] Moreover, similar to the results in Table XIV, the fiscal variable shows a much better performance when one uses a rational distributed lag rather than Almon, Koyck, and Pascal distributed lag techniques. However, the performance of fiscal variable is quite similar in the Almon, Koyck, and Pascal distributed lag results on the St. Louis reduced form equation. Consequently, Andersen and Jordan's critics are right in arguing that there is some considerable response of change in GNP to fiscal variables. This response is also quite sensitive to the different types of distributed lag. However, the overall results of this study support the original St. Louis study that the effects of a change in monetary variable are greater, faster, and more predictable than the effects of fiscal variable on change in GNP.

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[7]Sum of beta coefficients, in Table XIX, for the change in fiscal variable is greater than zero.

CHAPTER V

SUMMARY OF CONCLUSIONS AND RESULTS

The objective of this study has been to re-examine the following econometric issues:

1. To determine the exogenous components of autonomous expenditures and monetary variables in the studies by Friedman and Meiselman (31) and their critics. The definition of appropriate autonomous expenditures and exogenous monetary variables are the major differences among Friedman and Meiselman and their critics. Friedman and Meiselman use M_2 as the exogenous monetary variable, whereas some of their critics (Ando and Modigliani (6)) believe that M_2 cannot be regarded as an exogenous monetary variable. They argue that M_2 affects consumption (C) and C affects M_2 by altering interest rates, borrowed reserves, and excess reserves. Moreover, all of Friedman and Meiselman's critics claim that many of the Friedman and Meiselman (31) components of autonomous expenditures are not exogenous[1] and should be eliminated from the independent variable, autonomous expenditures. Therefore, this controversial issue is re-examined and clarified thoroughly in this paper and an attempt is made to find a better answer to this unexplained problem.

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[1]Friedman and Meiselman (31) define autonomous expenditures, A, as A = Net private domestic investment plus the government deficit on income and product account plus the net foreign balance.

2. To find the exogenous components of monetary variables in the studies by Andersen and Jordan (2) and by their critics. This issue has been one of the controversial arguments among Andersen and Jordan and their critics. Andersen and Jordan (2) use MB as the exogenous monetary variable, whereas their critics believe that there is an endogenous movement in borrowed reserves and currency. Therefore, they argue to delete them from the monetary base. Moreover, some alternative definitions of monetary variables (such as free reserves and unborrowed reserves) are suggested by Andersen and Jordan's critics, but they are also criticized on the grounds that they cannot be theoretically represented as proper measure of monetary variable in the St. Louis reduced form equation. Consequently, this issue, determining the proper measure of monetary variable, has been also one of the major objectives of this paper.

3. To determine the proper measure of fiscal variable in Andersen and Jordan's (2) study. The definition of fiscal variable given by Andersen and Jordan[2] is criticized by a number of economists on the grounds that it is neither exogenous nor is it a good measure of fiscal variable. Instead, Andersen and Jordan's critics suggest some alternative definitions of monetary variable which are thoroughly studied and their exogeneity investigated in this paper.

4. To test sensitivity of Andersen and Jordan's (2) results in using different distributed lag structures. Andersen and Jordan (2) use the Almon distributed lag with the fourth degree polynomial in their single equation model. Therefore, a number of economists pose the

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[2]Andersen and Jordan (2) use full-employment expenditures and taxes as measure of fiscal variable.

question of whether application of other distributed lag can change the results of Andersen and Jordan's study. Therefore, this study also has clarified this controversial issue and provided the reader with a better answer to the aforementioned question.

The first two issues are examined by applying Granger's (40) and Sims' (67) tests of causuality to all the alternative definitions of autonomous expenditures, monetary variables, and their components as given by Friedman and Meiselman (31) and by their critics. These tests are also applied to different definitions of monetary and fiscal variables as suggested by Andersen and Jordan (2) and by their critics. The third issue is examined by using the weighted standardized deficit as a measure of fiscal variable rather than the weighted full-employment expenditures and surplus as introduced by Andersen and Jordan. Finally, the last issue is studied and clarified by comparing the results of applying four different distributed lag structures (Almon, Koyck, Pascal, and rational distributed lags) to the Andersen and Jordan's reduced form equation. The final summary review of the findings of this study and conclusions are in the following two sections.

Section 1: Friedman and Meiselman and Their Critics

The literature reveals a generally agreed upon need for exogeneity in the explanatory variables. Results of this study clearly indicate through the outcomes of both the Granger's (40) and Sims' (67) tests of causality that none of the definitions of autonomous expenditures and monetary variables as given by Friedman and Meiselman (31) and by their critics are exogenous. Rather, the results suggest two new definitions of autonomous expenditures, A_1 and A_2. These two autonomous expenditures are defined as follows:

$$A_1 = T_2Y + T_1B + T_2B + G_2P + G_1G + G_1S + I_f + F$$

$$A_2 = A_1 + G_2T + G_2I \; .$$

Moreover, this study suggests using source base (SB) or time deposits (TD) as an exogenous monetary variable in Friedman and Meiselman's single equation model. Consequently, one can conclude that the results of Friedman and Meiselman and their critics are not reliable or consistent because of failure to use exogenous variables in their single equation model. The other major results of this study can be summarized as follows:

1. In contrast to Friedman and Meiselman's (31) remark of weak or nonexistent roles of autonomous expenditures in economic activity, the results indicate significant regression coefficients and greater beta coefficients for autonomous expenditures, in both simple and multiple regression equations.

2. The autonomous expenditures show higher correlation coefficients than monetary variables with consumption expenditures in some sub-periods of 1929-1977.

3. Results also suggest greater beta coefficients for TD than for SB, in both simple and multiple regression equations.

The overall results of this study imply that the relative importance of real and monetary variables is indeterminate. It depends upon whether the monetary variable is SB or TD; it depends upon whether data are quarterly or annual; moreover, it depends upon the time period. Consequently, it seems to be incorrect to claim that one theory dominates the other. Both yield significant coefficients in multiple regression using annual data and both have high explanatory power.

Section 2: Andersen and Jordan and Their Critics

The outcomes of Granger's and Sims' tests of causuality do not support all definitions of exogenous monetary and fiscal variables given by Andersen and Jordan (2) and by their critics; that is, with the exceptions of MB, FR, UR, and TA, all other definitions of monetary and fiscal variables are found to be endogenous. However, although UR and FR are statistically exogenous, the empirical and theoretical studies by Andersen and Jordan (3) and by Meigs (58) have indicated that they cannot theoretically be represented as the proper measure of monetary variable in determining the change in GNP. Consequently, even though the result of Granger's test has not resulted in agreed upon exogeneity of MB,[3] this study does suggest using MB as the proper measure of monetary variable in the St. Louis reduced form equation. Moreover, the results of these two tests support use of the weighted standardized deficit, rather than weighted full-employment surplus, as the proper measure of fiscal variable.

The sensitivity of Andersen and Jordan's (2) results to the different distributed lag techniques is tested by applying Almon, Koyck, Pascal, and rational distributed lags to two different sets of reduced form equations using different time periods. First, these distributed lags are applied to Andersen and Jordan's reduced form equation by using

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[3]MB is exogenous in Sims' test, but it is endogenous in Granger's test of causality.

the sampe periods of data in their study. Second, they are applied to the reduced form equation using ΔMB and ΔTA as the measures of monetary and fiscal variables, respectively. This second set of reduced form equation is estimated by using the data from the fourth quarter of 1959 through the second quarter of 1974. The outcomes of estimating the two aforementioned sets of reduced form equations have resulted the following:

1. The results of applying Almon, Koyck, and Pascal distributed lags to the first reduced form equation indicate greater beta coefficients for ΔMB than for ΔR, ΔE, or ΔS.

2. The outcomes of applying rational distributed lag to the first reduced form equation show greater beta coefficients for ΔS than for ΔMB. Consequently, if Andersen and Jordan (2) had used the rational distributed lag rather than the Almon distributed lag in their study, they would believe that the response of change in GNP to fiscal variable is also greater than zero.

The results for the second reduced form equation are very similar to what are found for the first one; that is, beta coefficients for ΔMB are substantially greater than those for ΔTA when one uses Almon, Koyck, and Pascal distributed lags. Moreover, fiscal variable performs better when rational distributed lag is used to estimate the second reduced form equation. However, these results clearly indicate that money multipliers in all types of distributed lags are greater than the multiplier for the fiscal variable (TA). Additionally, the response of change in GNP to fiscal variable is also considerably greater than zero. The most significant finding from the above results is that fiscal variable is more sensitive than monetary variable to the types of distributed lag for the time periods studied. In addition, this study indicates that money multipliers are considerably greater and generally more significant than the multiplier for fiscal variable in all types of distributed lags during both periods of data 1952_{I}-1968_{II} (except for rational distributed lag) and 1959_{IV}-1974_{II}. Moreover, the overall conclusion of Andersen and Jordan's (2) study is left untouched when the St. Louis reduced form equation is re-estimated, with TA representing as fiscal variable, for the period of 1959_{IV}-1974_{II}. But, in contrast to Andersen and Jordan's remark of weak and nonexistent roles of fiscal variable in economic activity, the results show a relatively important role for the fiscal variable in determining the change in GNP.

The overall result of this study does not reject Andersen and Jordan's (2) three propositions that the response of economic activity to monetary variable relatively to fiscal variable is (1) greater, (2) more predictable, and (3) faster. Nevertheless, fiscal variable is not negligible, but does have a substantially great impact on GNP. Results, obviously, depend upon the time period and depend upon the choice of distributed lag for estimating regressions.

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APPENDICES

APPENDIX A

DESCRIPTION OF VARIABLES

TABLE XX

DESCRIPTION OF VARIABLES

C	Private consumption expenditures
N	Net national product

Autonomous Expenditures and Their Components Defined By Friedman and Meiselman and By Their Critics:

D	Depreciation
I	Net private domestic investment
ES	Exports
G	Total government expenditures
F	Change in inventories
T	Taxes of federal and state government
$G_1G = T_2G$	Federal grants in aid to state government
G_1I	Net interest paid by federal government
G_2I	Net interest paid by local government
G_1P	Federal government purchases of goods and services
G_2P	Local government purchases of goods and services
G_1S	Subsidies - current surplus of government enter prise - wage accruals less disbursement (federal)
G_2S	Subsidies - current surplus of government enter-prise - wage accruals less disbursement (local)
G_1T	Federal government transfer of payment
G_2T	Local government transfer of payment
Id	Producer's durable equipment
I_f	Net foreign investment

TABLE XX (Continued)

Im	Imports of goods and services
Nc	Gross non-residential structure
Rc	Gross residential structure
T_1A	Contributions for insurance (federal)
T_2A	Contributions for insurance (local)
T_1B	Indirect business tax (federal)
T_2B	Indirect business tax (local)
T_1C	Corporate profit taxes (federal)
T_2C	Corporate profit taxes (local)
T_1Y	Personal tax and non-tax receipts (federal)
T_2Y	Personal tax and non-tax receipts (local)
A	Autonomous expenditures defined by Friedman and Meiselman ($A = G - T + ES - Im + Id + Nc + Rc + F - D + I_f$)
L	Autonomous expenditures defined by Deprano and Mayer and by Hester ($L = I + G + ES - Im$)
L'	Autonomous expenditures defined by Hester ($L' = L + Im + D$)
L"	Autonomous expenditures defined by Hester ($L'' = L' - Im$)
L'''	Autonomous expenditures defined by Hester ($L''' = L' - F$)
H	Autonomous expenditures defined by Ando and Modigliani ($H = I + G + ES +$ property portion of indirect business tax $- G_1I - G_2I + G_1T + G_2T -$ unemployment insurance $+ G_1S + G_2S$)
A_1 and A_2	New autonomous expenditures defined in this study
	$A_1 = T_2Y + T_1B + T_2B + G_2P + G_1G + G_1S + I_f + F$
	$A_2 = A_1 + G_2T + G_2I.$
W	Excess of wage accruals over disbursements.

TABLE XX (Continued)

Monetary Variables and Their Components Defined By Friedman and Meiselman and By Their Critics:

M_1	Money 1 = (CP + DD)
M_2	Money 2 = (CP + DD + TD)
CP	Currency held by the public
DD	Demand deposits
TD	Time deposits at comercial banks
SB	Source base = Total reserves + currency

Defintions of Variables and Their Components in Study of Andersen And Jordan And Their Critics:

CP	Currency held by the public
M_1	Money 1
M_2	Money 2
MB	Monetary base
BR	Borrowed reserves
UR	Unborrowed reserves
FR	Free reserves
S	Weighted full-employment surplus
R	Weighted full-employment receipts
E	Weighted full-employment expenditures
RN	(This period price) x R / (last period price)
TA	Weighted standardized deficit

TABLE XX (Continued)

Other Variables:	
r_{CA}	Simple correlation coefficient (the proportion of the variance in C that A alone explain, and similarly for other subscripts.)
$r_{CA_i.SB}$	Partial correlation coefficient (the correlation between C and A_1 after SB has been allowed its effect, and similarly for other subscripts.)
r	Multiple correlation coefficient
β_{A_1}	Beta coefficient for A_1,and similarly for other subscripts.

APPENDIX B

DERIVATION OF CHANGE IN THE WEIGHTED STANDARDIZED SURPLUS

Blinder and Solow (11, p. 67) defined the IS-LM model as the following three equations:

$$Y = C(r, Y-T) + I(r, Y) + G \qquad \text{(IS curve)} \qquad (1)$$

$$T = T(Y,t) \qquad \text{(Tax function)} \qquad (2)$$

$$M/P = L(r,Y) \qquad \text{(LM curve)} \qquad (3)$$

where C is real consumer spending which is a function of disposable income (Y-T) and interest rate (r); I is real investment; G is government expenditures; t is the tax rate; L is the liquidity preference function; M and P are nominal money supply and price index, respectively. They, for simplicity, assume the price level is fixed and ignore all wealth effects. Consequently, if one substitutes the tax from equation (2) into equation (1), the IS-LM model reduces to:

$$Y = C[Y-T(Y,t), r] + I(r,Y) + G \quad \text{and} \qquad (4)$$

$$M/P = L(r,Y). \qquad (5)$$

One can obtain the equation (8) by taking the total differential of equations (4) and (5):

$$dy = C_y dy - C_y T_y dy - C_y T_t dt + C_r dr + I_r dr + I_y dy + dG \qquad (6)$$

$$dM/P = L_r dr + L_y dy \quad \text{or} \quad dr = (dM/P - L_y dy) \,/\, L_r \qquad (7)$$

and substitute the value of dr from equation (7) into the equation (6) and solve for dy as follows:

$$dy\{1-C_y(1-T_y) + [(C_r+I_r)/L_r](L_y-I_y)\} = [(C_r+I_r)/L_r]\,\frac{dM}{P} - C_y T_t(y,t)\,dt + dG\,. \qquad (8)$$

Equation (8) can also be written as

$$dy = - mds + m\ [(C_r + I_r)/L_r]\ \frac{dM}{P}$$

where $m = \{1 - C_y(1 - T_y) + [(C_r + I_r)/L_r](L_y - I_y)\}^{-1}$ and

$$ds = C_y T_t(y,t)\ dt - dG\ .$$

ds is what Blinder and Solow call change in the weighted standardized surplus.

This definition, later is used by Blinder and Goldfeld (9) to measure TA which is akin to the weighted standardized deficit. They estimated TA as follows:

$$TA = F_y(t) + K_A(t)$$

where $F_y(t)$ is the impact of fiscal action of quarter t on real GNP of that quarter and $K_A(t)$ is overhang of fiscal policy executed prior to quarter (t) on real GNP of that quarter, using truncation procedure A.[1]

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[1]Truncation A means that the steady state is reached after 2 years. In other words, it means that the overhang of fiscal policy lasts only 2 years and thereafter TA will be equal to $F_y(t)$.

VITA [2]

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