AN ECONOMETRIC ANALYSIS OF SOME MAJOR EXOGENOUS DETERMINANTS OF NATIONAL OUTPUT

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ABSTRACT

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By

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In a stylized sense, there exist two theories of national output determination. They are the Quantity Theory of Money and the Income-Expenditure Theory. Each theory places primary emphasis on different items as the major driving force behind changes in aggregate economic activity. In the Quantity Theory, emphasis is placed upon the stock of money, while in the Income-Expenditure approach, emphasis is placed upon autonomous expenditures. Although it is not necessary that the two theories be mutually exclusive, a considerable amount of empirical testing has been completed in recent years attempting to compare the relative stability of the theoretical relationships implied by the two theories. The purpose of this dissertation is to study the relationships implied by these two theories within the framework of a complete macro-econometric model.

A nine-equation macro-econometric model is constructed. An attempt is made to incorporate recent theoretical developments into the model. For example, it is assumed that

consumption expenditures are related to permanent disposable income. Investment expenditures are related not only to an interest rate variable, but also to an accelerator variable and the level of aggregate economic activity. Investment expenditures are linked to financial markets by means of the term structure of interest rates. The short-term rate of interest is determined by the interaction of the demand for and supply of money. The supply of money is endogenously determined.

The model shows that government expenditures have a greater initial impact on the level of aggregate activity, as measured by the level of Gross National Product, than does the monetary base, the variable assumed to be under the control of the monetary authorities. The model shows, however, that the major effects of monetary policy come several quarters after the initial change. At the end of one year, the accumulated effect of a change in the monetary base is greater than the accumulated effect of a change in government expenditures. This must be interpreted cautiously, however, for the average change in government expenditures exceeds the average change in the monetary base, in the time period used in estimation of the model. The model also shows that whereas the impact of government expenditures is direct, the impact of monetary policy must work its way through financial markets before its impact is felt in real

markets. The linkages implied by the results of the model are not close.

The literature contributing to the recent empirical tests is surveyed and the results obtained by the single-equation models are evaluated. The reduced-form hypothesis is restated and regressions are run for the time period covered by the complete model estimated in this thesis. An attempt is also made to re-evaluate the results obtained in earlier studies by correcting standard errors for the presence of autocorrelation in the residuals.

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CHAPTER I

INTRODUCTION

In a stylized sense, there exist two important and competing theories of income determination. One theory is the income expenditure approach that in an extreme form hypothesizes that the equilibrium level of income is determined solely by the level of autonomous expenditures in the economy when the technological and behavioral structure is given. Any change in autonomous expenditure will result in a change in aggregate income that is a multiple of the initial change. By controlling or influencing the autonomous component of aggregate demand, any level of aggregate income consistent with the technological constraints and factor endowments of an economy can be attained.

The other, the Quantity Theory of Money, states that when the technological and behavioral structure of an economy is given, aggregate income is determined mainly by the amount of money that exists in the economy; and any change in this stock of money will be reflected directly in a change in the level of money income. The conclusion one can draw from these extreme characterizations is that vastly different views of aggregate income determination are implied by the two theories. In this sense, the two theories are competitive, and it is clearly of the first importance to determine which is the more appropriate, if for no other reason than their differing suggestions for economic policy.

Simplified Exposition of the Existing Theories of Income Determination

The Quantity Theory of Money is the older of the two, at least from the standpoint of presenting a hypothesis in which a limited number of identifiable variables can be used to examine the behavior of an economy. Although early formulations did not receive mathematical expression, it is obvious that they conform very closely with those developed by Irving Fisher in the United States and Alfred Marshall in England. The simplest form of Fisher's model of the Quantity Theory is

$$M \times V = P \times T \tag{1.1}$$

where M = nominal money supply

V = income velocity of circulation

P = general index of prices

T = number of final transactions that take place in the economy.

In the crudest form of this theory it was generally assumed that the velocity of circulation was determined by institutional factors, such as payment habits, and only changed slowly over time. For short-run analysis, it could be taken as constant. The number of transactions that took place was limited to the amount of goods that the economy could produce. If the adjustments of wages and prices allowed the economy always to operate at full employment, the number of transactions could be taken as a constant, limited by the full-employment productivity of the economy. Since prices were assumed to be perfectly flexible, any change in the stock of money would be reflected in price changes, and these price changes would be a constant multiple of the change in the stock of money.

$$(1.2) \qquad \frac{dP}{dM} = \frac{V}{T} = \text{a constant.}$$

The development by Marshall was similar to that of Fisher, except Marshall devoted primary attention to peoples' desires to hold money, rather than the number of times a given money supply turned over. This resulted in the so-called "Cambridge equation."

$$(1.3) \qquad M = k\ PT$$

where $k = \frac{1}{V}$. The value k represents the proportion of money which people would like to hold in cash balances relative to the total money income of the society, i.e., PT. If one makes assumptions that are consistent with the attainment of full employment such as wage and price flexibility and if people desire to hold a fixed proportion of their incomes in money balances, then Marshall's model of the Quantity Theory gives exactly the same conclusions as Fisher's model.

$$\frac{dP}{dM} = \frac{1}{kT} = \frac{V}{T} = \text{a constant.} \quad (1.4)$$

Because accumulated experience apparently did not conform closely with the above theory, particularly in the Great Depression, the income expenditure theory developed by John Maynard Keynes was enthusiastically received by most of the economics profession. Income velocity did not appear to be constant and changed rapidly over time. In fact, it was felt that velocity could change so rapidly and in such magnitude that it could offset any changes in the stock of money. Secondly, wages and prices did not appear to be flexible, at least in the short run, so that automatic adjustment to a full employment level of output might not be possible. Thirdly, expectations of the future, particularly in a depression, might be quite pessimistic and upset normal behavior so that it would be impossible to increase aggregate expenditures by private means. Consequently, it was necessary to look at the various components of these expenditures to determine just what it was that affected them and how corrective measures could be taken to increase the level of activity in the economy. The income-expenditure theory in its simplest form is as follows:

$$(1.5)\qquad C = f(Y) = a + bY$$

$$(1.6)\qquad A = \overline{A}$$

$$(1.7)\qquad Y = C + A$$

$$(1.8)\qquad Y = \alpha + \beta' A$$

where C = consumption expenditures

Y = aggregate income (P x T)

A = autonomous expenditures

β' = the Keynesian Multiplier.

In this model, prices are assumed to be inflexible, consequently, any change in aggregate income represents a change in the real output of the economy. Changes in autonomous expenditures are the sole source of changes in aggregate income and the increase in income is a constant multiple of these changes.

$$(1.9)\qquad \frac{dY}{dA} = \beta'$$

Beginning with the classic effort of Hicks,[1] theorists have attempted to consolidate the two models since under less rigid assumptions they need not be mutually exclusive. However, much economic discussion, particularly at the elementary level, is stated in the terms of the two theories presented above. Also, policy recommendations are often

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[1]J. R. Hicks, "Mr. Keynes and the 'Classics': A Suggested Interpretation," Econometrica, V, 1937, pp. 147-159. Reprinted in Readings in the Theory of Income Distribution (Homewood, Ill.: Richard D. Irwin, Inc., 1951, pp. 461-476.

couched in terms of one theory or the other. Consequently, it is necessary to discuss the merits of these two simple theories and examine their strengths and weaknesses in order to see how more complex models improve our understanding of the world relative to these simple theories.

Purpose and Principal Hypothesis of This Study

The purpose of this study is to examine the relative merits of the two theories in a statistical investigation. The stimulus for the present work has been a paper by Milton Friedman and David Meiselman prepared for the Commission on Money and Credit.[2] In this paper the two theories were tested in their simple "crude" forms. The models were chosen because they reflected the forms presented in elementary textbooks. A number of subsequent articles also tested crude forms of the two theories, although other tests were occasionally proposed but not implemented in a fully specified model.

The starting point of this study is that the extreme versions of the two theories are inappropriate in the light of current economic knowledge. In the face of recent refinements in macroeconomic model construction, these versions

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[2]Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958" in B. Fox and E. Shapiro, Stabilization Policies (Englewood Cliffs, N. J.: Prentice-Hall, 1963), pp. 165-268.

lead to misleading conclusions and unreliable statistical results. The theories, themselves, can hold in their crude forms only if one ignores almost all of the developments in economic science over the last 30 years. Therefore, it is necessary to develop more complete theories that can test not only the relative importance of the different explanatory variables, but also the way in which these variables effect other important items within the economic system.

Major Determinants of Aggregate Activity

In this investigation the major determinants of aggregate income will be those hypothesized above: the stock of money and autonomous expenditures. However, the problem of defining the components of these crucial variables has emerged as one of the major obstacles in this as well as several related studies. As will be pointed out later, the definitions chosen can alter one's conclusions rather dramatically.

Plan of the Study

In Chapter II the underlying model will be developed in relation to the published research that has already been done in this area. In this way one can isolate the crucial issues under debate and the problems that exist in any test of the two theories. In Chapter III models are developed that can be used to test, at various levels of aggregation, the hypotheses presented above. Chapter IV presents the additional empirical tests of the single-equation models while the results of a multi-equation econometric model are presented in Chapter V. In Chapter VI tentative conclusions are drawn in light of the work that has been finished so far.

CHAPTER II

A REVIEW OF THE LITERATURE

Introduction

This chapter presents a discussion of the recent controversy concerning the two theories of income determination. The seminal work was the paper prepared by Milton Friedman and David Meiselman for the Commission on Money and Credit.[1] This was soon followed by the articles of Donald Hester,[2] Albert Ando and Franco Modigliani,[3] and Michael DePrano and Thomas Mayer.[4] There have been other papers that have related to the continuing discussion in this area, but only two additional ones will be discussed in this paper.

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[1]Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in B. Fox and E. Shapiro, Stabilization Policies (Englewood Cliffs, New Jersey: Prentice-Hall, 1963), pp. 165-268.

[2]Donald Hester, "Keynes and the Quantity Theory: A Comment on the Friedman-Meiselman CMC Paper," The Review of Economics and Statistics, XLVI (November, 1964), pp. 364-368.

[3]Albert Ando and Franco Modigliani, "The Relative Stability of Monetary Velocity and the Investment Multiplier," The American Economic Review, LV (September, 1965), pp. 693-728.

[4]Michael DePrano and Thomas Mayer, "Tests of the Relative Importance of Autonomous Expenditures and Money," The American Economic Review, LV (September, 1965), pp. 729-752.

The empirical tests that have taken place since the Friedman-Meiselman paper play the main role in the development of this discussion. Although theoretical considerations are of the utmost importance, the original papers deal mostly with empirical relationships. Several times Friedman and Meiselman state that on a purely theoretical level, it is easy to derive simple income-expenditure models or simple Quantity Theory models. This assumes that the original system of equations is of the form in which only autonomous expenditures or money determinants are included. Using additional information, it is possible to reconcile the two theories and within a more sophisticated framework there is little disagreemnt as to the possibility of reaching one consistent theory in terms of a general equilibrium model for a free-market economy.

At a high level of abstraction there is a rich and full body of literature going back over many years. However, it is not the intention of this thesis to present a full discussion of the theoretical aspects of the two theories. The problem that Friedman and Meiselman pose is an empirical one. They are primarily concerned with the short-run relationship between "investment" expenditures and total expenditures and the money stock and total expenditures. It is assumed that the major area that separates the adherents of the divergent theories is the stability of these two relationships within a short-run framework.[5] Those who accept the income-expenditure approach feel that the more stable relationship of the two is that between "investment" expenditures and total expenditures, while those who profess the quantity-theory approach feel that the relationship between the money stock and total expenditures is the more stable.

Thus the recent controversy has been centered on the statistical comparison of the two theories. A conclusion to the argument could have important reprecussions, particularly in the area of policy making. Although both relationships appear to be absolutely unstable, the fact that one is relatively more stable than the other would seem to indicate that the more stable of the two would be a more trustworthy instrument to use in carrying out policy action. Also, policy makers are most often interested in the short-run behavior of the economy and not its long-run equilibrium.

The thesis will, therefore, be primarily interested in empirical questions. The literature discussed will be limited to those contributions that involve statistical testing relevant to the question. The volume of literature on this topic is not very extensive. The Friedman-Meiselman paper will be discussed first, then the content of subsequent articles will be developed in terms of the relevant areas of criticism. This seems to be the most efficient method of

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[5]Friedman and Meiselman, op. cit., p. 169.

presentation because there is a great deal of overlapping in these articles. The chapter will close with a brief discussion of other studies that relate to the topic under examination.

The Friedman-Meiselman Paper

Friedman and Meiselman feel that most economists must make empirical judgments on two important questions.[6] The first concerns the source of change in economic activity and the effects these changes have on other economic variables. This question concerns which economic variables are most truly exogenous and represent the autonomous "shocks" to an economy. Closely linked to this is the problem of determining which of these exogenous variables can be controlled, or how closely they can be controlled, so as to be of use in implementing economic policy.

This problem has been dealt with elsewhere and is not treated to any great extent in this paper and a fairly consistent effort has been made to keep this type of discussion on the sidelines. However, the implication is always present that this question has been answered satisfactorily.

The second empirical judgment concerns the relative stability of different relationships. Stability, in this case, is defined as an empirically consistent relationship.

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[6]*Ibid*., pp. 168-169.

Given exogenous variables, it is desirable to know which have the most stable relationship with certain endogenous variables. The endogenous variables, of course, are variables that are important either as "final" determinants of economic activity (such as consumption expenditures) or as "intermediate" determinants (such as interest rates) that transmit their effects to other endogenous variables.

Friedman and Meiselman specifically use the coefficient of correlation as their measure of the consistency of a relationship. Their argument reduces to the fact that if two variables appear to move more closely together, as measured by their coefficient of correlation, than two others do, the former relation is a relatively more stable relation than the latter.

One should be careful to distinguish between relative stability, as measured by the comparison of two values, and the absolute stability. One of the major criticisms of the naive Quantity Theory was that the income velocity of circulation was not constant. At certain times, particularly in periods of depression, velocity might change rapidly and offset any efforts of the monetary authorities to correct the situation. This criticism was in terms of the absolute stability of income velocity and is accepted by almost all contemporary economists, including Friedman and Meiselman.

Due to this variability of the velocity of circulation, an alternative hypothesis, the income-expenditure approach, was developed. It gained support because it proposed relationships that were supposedly more stable than the relationship between money and income. In the early development of the income-expenditure approach, the aggregate consumption function was thought to be a very stable economic relationship over time. The marginal propensity to consume, which was derived from the consumption function, was important because it was the major determinant of the income multiplier. If the marginal propensity to consume happened to be constant then the multiplier would be constant. Later studies of the consumption function have indicated, however, that the consumption function is not as stable over the short run as it was first thought to be. Consequently, the multiplier relationship was not as stable over the short-run as originally believed.

Rather than attempting to determine the absolute stability of the two relationships, Friedman and Meiselman felt that it would be more informative to test the stability of the one relationship relative to the other. To do so, they set up simple models of the two theories. They felt that tests had to be carried on at this level if the two theoretcal concepts, in the terms of their crude ancestors, were to be compared.

The simplest form of the income-expenditure approach states that income is directly related to autonomous expenditures. This was expressed in equation (1.8) in Chapter I.

$$(2.1) \qquad Y_t = \alpha + \beta' A_t$$

Changes in income are assumed to be a constant multiple of changes in autonomous expenditures.

$$(2.2) \qquad dY_t = \beta' \, dA_t$$

As mentioned above, the multiplier is directly derived from a consumption function like that in equation (1.5) and is of the following form:

$$(2.3) \qquad \beta' = \frac{1}{1 - MPC}$$

In the crude model the MPC is assumed to be constant and this leads to the conclusion that the multiplier is a constant. As was mentioned above, recent developments have shown that the MPC is not constant, particularly in the short run, and this leads one to question the stability of the multiplier. It should be noted that one of the problems of this analysis is that the consumption function used to develop the simple multiplier model does not conform to recent developments in the field. Current advancements require that the consumption function be specified in a more sophisticated manner to be better able to explain observed behavior. For example, the permanent income hypothesis was developed to explain the behavior of the consumption function and to help account for the instability of the short-run multiplier. It would seem reasonable to expect that if the more sophisticated consumption function explains observed behavior better, the simple consumption function could be expected to yield poorer results in terms of a lower coefficient of correlation than could otherwise be obtained.

Autonomous expenditures constitute a major portion of income; therefore, it was felt that the relavant test of the income-expenditure approach would be to relate autonomous expenditures to induced expenditures. Otherwise, autonomous expenditures would appear on both sides of the equation (2.1) and since this variable is subject to errors in measurement, it would introduce spurious correlation.[7] This equation was altered to obtain the following:

(2.4) $$C_t = \alpha + \beta A_t + u_1$$

where $\beta = \beta' - 1$

u_1 = stochastic error term with zero mean, constant variance and zero covariance.

The α can be tested for significance to determine whether the average and marginal multipliers are the same. It has generally been assumed by economists that they are not the same.

Friedman and Meiselman developed the Quantity Theory in the following way:

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[7] *Ibid.*, p. 175.

(2.5) $Y_t = \delta + \gamma' M_t + u_2$

where Y_t = nominal income

M_t = money Stock--coin and currency in hands of the nonbank public plus all commercial bank deposits.

u_2 = stochastic error term with zero mean, constant variance and zero covariance.

In order to compare the results of the tests on the two equations, the dependent variable in each must be the same.[8] That is, the dependent variable of equation (2.5) must be altered to correspond with that of equation (2.4). Friedman and Meiselman felt that this would put the Quantity Theory at a disadvantage and were therefore surprised that the results were so one-sided. In particular, they found that the money stock was closely related to consumption expenditures and in many cases the relationship was closer than that between the money stock and aggregate income. They proceeded to justify their empirical results in terms of the permanent income hypothesis.[9] Since consumption is more closely related to permanent income than to current income, it must be more closely related to the money stock, because the demand for money is a function of permanent income and not current

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[8]<u>Ibid</u>., p. 176.

[9]<u>Ibid</u>., pp. 176-177.

income. The revised Quantity Theory model is:

$$(2.6) \qquad C_t = \delta + \gamma M_t + u_3$$

where C_t = induced expenditures

u_3 = stochastic error term with zero mean, constant variance and zero covariance.

In the usual formulation of the Quantity Theory the average velocity and the marginal velocity are assumed to be equal. That is, $\delta = 0$. It was decided to test this hypothesis by leaving 'δ' in the equation.

So far, the development of the models has been in nominal terms. Since the income expenditure theory is often stated in real terms, further tests of the two hypothesis would consider prices. It was decided that instead of deflating the two equations, (2.4) and (2.6), the price level would be added to the equations as an independent variable. This was done to avoid spurious correlation caused by errors of measurement in variables that would be included on both sides of the equation.[10]

$$(2.7) \qquad C_t = \alpha + \beta A_t + \lambda P_t + u_4$$

$$(2.8) \qquad C_t = \delta + \gamma M_t + \lambda P_t + u_5$$

[10] Ibid., p. 178.

The addition of prices presents many problems. One problem has to do with the distribution of changes in nominal income between real output and prices. Another concerns the direction of causation. Whereas it is assumed that the Federal Reserve System can control the nominal supply of money, the central bank cannot determine the real money supply. This might mean that the situation in the real sector, i.e., the relationship of aggregate demand to aggregate supply, would affect the real supply of money and not the opposite way around.[11]

Finally, the two theories were combined into one reduced form. This was done so as to test the relative importance of the two independent variables. It could also be true that some of the movement in one variable might represent the hidden influence of the other. It was felt that the expanded reduced form would allow this to be tested. This would, of course, invalidate the previous tests if (2.9) and (2.10) represented true reduced forms. The equations tested were:

$$C_t = \alpha + \gamma M_t + \beta A_t + u_6 \qquad (2.9)$$

$$C_t = \alpha + \gamma M_t + \beta A_t + \lambda P_t + u_7 \qquad (2.10)$$

The results of these two equations were analyzed in the following way. If the partial correlation coefficient of one of the independent variables was nearly equal to its

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[11] Ibid., pp. 178-179.

simple correlation coefficient, then it would be assumed that the variable in question exhibited little or no hidden influence of the other variable. However, if the partial correlation coefficient were much less than the simple correlation coefficient, it could be assumed that the variable in question reflected in part the movement of the other explanatory variable. Therefore, the relationship shown in the simple regression models, (2.4) or (2.6), between the independent variable and consumption would appear to be primarily the hidden influence of the other explanatory variable working through the explanatory variable being tested.

Friedman and Meiselman also discuss further elaboration of the two theories. Any further elaboration would include explanations of the velocity of circulation (γ) and the multiplier (β) and the determinants of the independent variables. In particular, the equations tested are true reduced forms only within the extremely simple models specified above. If the models are improperly specified, one may seriously question the validity of the results. As will be shown later, there are serious statistical problems that arise due to the misspecification of a model by not using all the information that is available to the researcher.

In regard to the results of these tests, it has been noted that when two variables are synchronous and are closely related to one another this does not imply that one is "determining" the other. Friedman and Meiselman make it very clear that even when they examine the equations with lagged variables, a high correlation between a lagged variable and a dependent variable does not necessarily imply causation. Both variables might move together because of the influence of a third variable. Therefore, it is necessary, when examining lagged relationships, not to draw any hasty conclusions about the direction of causation.[12]

One of the major problems encountered in the study was the definition of the variables. It is readily apparent that in tests where the data are so highly aggregated, a slight change in a definition can alter the conclusions considerably. Friedman and Meiselman attempt to define the variables in an objective way so that their definitions can be duplicated in similar tests by others. This, they hope, will allow economists to get away from the reliance on *a priori* definitions or the use of intuition.

One method of determining the appropriate composition of a variable would be to regress income on the various combinations of the variable and accept the combination that was most closely related to income in terms of the coefficient of correlation. However, Friedman and Meiselman felt that this presented a problem, for in the case of autonomous expenditures this approach would result in regressing income on part of itself. Consequently, this would introduce spurious correlation.

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[12] *Ibid.*, p. 179.

In order to derive a different test, Friedman and Meiselman assumed that the components of a given variable were close substitutes. In fact, the components were assumed to be such close substitutes that it would be better if they were treated as one variable, or as perfect substitutes, than to treat them separately. Thus, they hypothesize that in the case of perfect substitutes, switching a dollar from one component to another should not affect the relationship of the total with income. In the case of autonomous expenditures, it would not affect the relationship of the total of the two with the induced component of income. Because of this, income or the induced component of income should move more closely with the total value of the autonomous variable than with the individual components of the autonomous variable. However, in the case where components are not good substitutes, switching a dollar from one component to another should affect the value of income and, therefore, the induced component of income. Consequently, income should move more closely with the individual components than with the total value.

In order to describe this test further, it is helpful to proceed by means of an example. This is the same one used by Friedman and Meiselman.[13] Assume that there exists a preliminary definition of autonomous expenditures (A).

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[13]*Ibid*., pp. 182-183.

The question arises whether durable consumer goods (D) should be included in this definition of autonomous expenditures or not. Let N represent expenditures on non-durable goods. If D and A are perfect substitutes, then shifting \$1 from D to A or from A to D would have no effect on N. If this were true, then the statistical relationship between N and (D+A) should be closer in terms of a higher coefficient of correlation than that between N and A and N and D alone. The test, therefore, requires that the regressions of N on (D+A) and N on D and N on A should show that the correlation between N and D or N and A alone would be lower than the correlation with their sum. That is,

$$(2.11) \qquad r_{N(D+A)} > \left[\begin{array}{l} r_{ND} \\ \text{and} \\ r_{NA} \end{array}\right.$$

This might not be satisfied and so an alternative test is developed. D might be a part of induced expenditures. Therefore, changes in N and D could be independent of A and changes in A might only affect their sum. Additional regressions need to be run of A on (D+N) and A on D and A on N. In this case, the following conditions need to be met.

$$(2.12) \qquad r_{A(D+N)} > \left[\begin{array}{l} r_{AD} \\ \text{and} \\ r_{AN} \end{array}\right.$$

Friedman and Meiselman use the following criterion to determine whether D should be included in A or not.

Possibility	Condition (2.11)	Condition (2.12)	Conclusion
(a)	Satisfied	Not Satisfied	D Autonomous
(b)	Not Satisfied	Satisfied	D Induced
(c)	Satisfied	Satisfied	Ambiguous
(d)	Not Satisfied	Not Satisfied	Ambiguous

The results of the test may turn out to be ambiguous. Friedman and Meiselman state that "when the results (are) ambiguous, (they) . . . followed the procedure that seemed more in accord with the general presumptions in the literature about the income-expenditure relations."[14]

The results of the test limit the definitions of money and autonomous expenditures to the following items:

Money = Coin and currency in the hands of the non-bank public plus adjusted demand deposits plus adjusted time deposits at commercial banks.

Autonomous Expenditures = Net private domestic investment plus the government deficit on income and product account plus the net foreign balance.

The consumer price index was chosen as the second regressor in (2.7), (2.8) and (2.10) because the dependent variable was consumer expenditures.

For the most part, the study used annual data. This was because of the lack of quarterly data before 1941. Annual

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[14] *Ibid*., p. 183.

data were also used in testing for the definitions. In this respect Friedman and Meiselman contend that perhaps the final form of the definitions arrived at in this way may not be the appropriate ones for a shorter time period, such as calendar quarters. They feel that ". . . quarter-to-quarter changes reflect very short period relationships and that for such short periods our definition of autonomous is not appropriate, that the autonomous category should be enlarged to include all of exports and not simply the foreign balance and all of government expenditures and not simply the deficit."[15]

The period covered is from 1897 to 1958. Since the study was more interested in the short-run stability of the two models, it was necessary to find some way to divide the data into shorter time periods. It was decided that sub-periods should be based upon turning points in the business cycle as determined by the National Bureau of Economic Research. Also, since the velocity of circulation and the multiplier could change decidedly over the business cycle it was necessary to test the theories at different points of time within the cycle. Therefore, two additional divisions were made. The first divided the data into time periods that conformed with the troughs of major depressions (1897, 1907, 1921, 1933, 1938, and the end of World War II). The second division made the separation at peaks intermediate between the troughs (1903, 1913, 1920, 1929, 1939, 1948, and

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[15]<u>Ibid</u>., p. 204.

1957). This allowed for a great deal of overlapping. This would provide some idea of how velocity and the multiplier behave over the cycle.

The results oftained by Friedman and Meiselman were quite one-sided. In all cases except the early years of the Great Depression, consumption expenditures were more closely related to the money supply than to autonomous expenditures. If the year 1929 is dropped from the tests, the money supply equation exhibits the more stable relation over most of the depression years.

Tests on quarterly data from the third quarter of 1945 to the fourth quarter of 1958 give the same one-sided results. The results carry over when first differences are used and also when the variables are expressed in real, rather than in nominal values.

To a large extent, it appears that the effects of autonomous expenditures on consumption represent the hidden influence of the money supply. The partial correlation coefficient between consumption and the money stock is almost the same as the simple correlation coefficient of consumption and the money stock. On the other hand, the partial correlation coefficient between consumption and autonomous expenditures is considerably lower than the simple correlation coefficient between these variables.

When lagged quarterly values are introduced, consumption seems to be most closely related to the money stock two periods earlier while consumption is most highly correlated with the contemporaneous value of autonomous expenditures. This implies that the money stock could have a strong influence on consumption expenditures over several quarters, while autonomous expenditures would have the greatest effect in the quarter in which they are made.

The results of tests on α and δ are interesting in the light of a priori reasoning. They both tend to conform to what one would expect. The test of the multiplier hypothesis seems to indicate that the intercept term is positive and significantly different from zero. This would imply that the average is greater than the marginal multiplier. The test of the Quantity Theory shows that the intercept term is not significantly different from zero. This would imply that the version of the Quantity Theory developed in Chapter I would be the correct specification and that the average velocity of circulation would be equal to the marginal.

The absolute stability of the multiplier and the velocity of circulation is also discussed briefly. "(A)lthough the multiplier was generally highly stable between cycles for this period the typically low intracyclical correlations between C and A indicate that the multiplier was highly unstable."[16] The results were just the opposite for velocity. "Although average and marginal velocities were highly stable

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[16] Ibid., p. 206.

intracyclically, secular shifts are immediately apparent."[17]

These two results agree with current theory. Since the multiplier is closely related to the marginal propensity to consume (MPC), a stable value for the multiplier would indicate that the MPC was fairly stable. Since the multiplier is fairly stable between cycles, it would appear that the long-run MPC is relatively stable. The variability intracyclically can be explained by the shifting of the short-run consumption function. This is consistent with much of the contemporary work that has been done on the consumption function, in particular the permanent income hypothesis.

The stability intracyclically of the velocity of circulation implies that the demand function for money is relatively stable within the cycle, which is generally assumed by quantity theorists. The instability between cycles can result from institutional changes or longer run effects. This is again consistent with the theoretical expectations of the latter school.

The conclusion drawn from the study by Friedman and Meiselman is that although the income velocity of circulation is not absolutely stable, it is nevertheless more stable in the short run than is the alternative hypothesis presented by the income-expenditure approach. As a result, if the money supply is controlled by the central bank and is a causative factor in income determination, then one should choose

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[17] Ibid., p. 206.

changes in the money supply as the more reliable policy instrument because it is more closely related to changes in income than are changes in autonomous expenditures.

These results run counter to the beliefs of many economists. It is generally felt that if the Quantity Theory is to hold, it will hold over the long run and not in the short run. Some of the difficulty in understanding the results of the Friedman-Meiselman tests is caused by the failure to consider that the tests are aimed at the relative stability of the two relationships and not their absolute stability. The Quantity Theory, in its more naive form, may be more relevant in the long run than in the short run. However, the tests are aimed at showing that even though the relationship between the stock of money and consumption is not absolutely stable in the short run, it is a more stable relationship than that proposed by the income-expenditure theory.

These tests were the first attempt to compare the relative stability of the two theories. It has been implied that there are many problems that exist in the study. It was to be expected that the paper would draw a rebuttal from the proponents of the income-expenditure approach. Soon after the publication of this paper, other economists published similar tests. They attempted, primarily, to stay at the same level of aggregation. Once a battleground is chosen, it is hard to shift the place of combat. The following discussion represents an attempt to classify some of the major points of criticism leveled at the Friedman-Meiselman paper.

Major Points of Criticism

The three articles that followed the Friedman-Meiselman paper were relatively consistent in their criticisms. There is much overlapping in these papers, consequently, only the main points of discussion will be presented. To some extent De Prano and Mayer missed the point of the discussion in their article because they seem to be unduly concerned with the two approaches as forecasting models, whereas the aim of the study was to determine which variable had the closer relationships with movements in income. However, many of their remarks are still relevant.

All of the discussants seemed to feel that the topic of greatest concern was the definition of autonomous expenditures. It was felt that the choice of the components of A seriously biased the tests against the income-expenditure model.

Hester, for example, concentrates mainly on the specification of the "Keynesian" model. By maintaining the same level of aggregation as the previous tests he ignores models that could reconcile the two theories. His model is one derived in the textbook by Dernberg and McDougall, which does not include a monetary sector.[18]

In so doing, he presents a strong argument against the use of an empirical technique in defining variables. He feels that if the main idea of the Friedman-Meiselman tests are to investigate the empirical foundations of elementary textbook models, then the definitions that are used should be the ones most commonly associated with the theory being tested. Choosing any other definition would result in a test, not of the model the researcher wants to subject to test, but of another model and its assumptions and definitions. Therefore, the results of the test cannot be used to draw conclusions about the original conceptual model.

Hester does criticize the Friedman-Meiselman definitional test, by stating that "their test is sensitive to the variances and covariances of I (Investment), G (Government Expenditures), and H (Exports). (C)omponents of autonomous expenditures will not be reliably selected by their procedure."[19] Friedman and Meiselman agree that Hester has a valid point, but state that he proposes no alternative. Therefore, until an alternative method is proposed, the old method should continue to be used.[20]

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[18]Thomas F. Dernberg and Duncan M. McDougall, Macroeconomics, Third Edition (New York: McGraw-Hill, 1968), Chapters 5 and 6.

[19]Hester, "Rejoinder," The Review of Economics and Statistics, XLVI (November 1964), p. 377.

[20]Milton Friedman and David Meiselman, "Reply to Donald Hester," The Review of Economics and Statistics, XLVI (November 1964), p. 370.

Hester proposes several different definitions of autonomous expenditures. For example, he says that in the Dernberg-McDougall model, all taxes are assumed to be endogenous. This is because a large proportion of tax collections depend upon the amount of income economic units receive. In the short run, these tax collections are divorced from the corresponding expenditures made by the government. The immediate conclusion is that autonomous expenditures should include the total of government expenditures and not just the deficit. This gives him his first definition of autonomous expenditures.

Imports are a function of the level of income and, therefore, should be considered endogenous. There is also a question as to the validity of the measurement of depreciation. Since this figure is just an estimate and bears little or no relation to economic depreciation, it was decided to use gross investment rather than data net of capital consumption allowances. The second definition used by Hester included Gross Private Domestic Investment, Total Government Expenditures, and Total Exports.

The third definition used by Hester subtracts imports from the second definition. This is done because some of the value of imports is double counted in consumption expenditures. If imports are not subtracted, they might introduce some spurious correlation. A fourth definition subtracts inventory investment because it is endogenously determined.

Hester feels that in their particular choice of A_t, Friedman-Meiselman introduce a downward bias in the correlation between consumption and autonomous expenditures. He states that the coefficient of correlation must be lower between C_t and A_t than between C_t and the first of Hester's definitions unless the latter correlation is equal to one. In this case, both coefficients of correlation will be equal to one.[21]

De Prano and Mayer also find fault with the definition of autonomous expenditure used by Friedman and Meiselman. However, they provide little explanation as to the method of choosing items they use in their definitions, but do make some interesting comments on the problems associated with the definition used in the previous tests.

Their first point concerns the effect of capital consumption allowances upon the values of the correlation coefficient. In all the time periods tested, they found that the gross concept of investment expenditures was more closely related to consumption expenditures than the net concept. From this they conclude that errors in measurement of capital consumption allowances are great enough to cause considerable bias to the tests and that the gross concept is better for statistical purposes. This conclusion is in agreement with the results of Hester's tests.

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[21]Hester, "Keynes and the Quantity Theory," op. cit., p. 366.

Their second point concerns the performance of an interesting experiment.[22] They correlate consumption with various components of autonomous expenditure, both in terms of levels and in terms of first differences. Additional variables are not added to the equation; only the definition of the regressor is changed.

The inclusion of some items in a definition raise the correlation coefficient and some lower it. It is apparent from their results that the items that tend to lower the correlation coefficient are those items that are considered endogenous in many short-run economic models.

De Prano and Mayer make little use of this test in defining their variables. Their purpose in mentioning these tests is that definitions of autonomous expenditure that have endogenous elements in their sum tend to lower the coefficient of correlation of autonomous expenditures with consumption expenditures.[23] Since Friedman and Meiselman's definition of autonomous expenditures does contain induced components, this would tend to bias their results downward and put the income-expenditure theory at a disadvantage relative to the Quantity Theory.

Ando and Modigliani also discuss the definition of autonomous expenditures. They, too, draw on the fact that

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[22]De Prano and Mayer, op. cit., pp. 734-738.

[23]Ibid., p. 734.

the definition has endogenous elements in it. They contend that the variable, therefore, is not independent of the disturbance term and introduces simultaneous equation bias into the results. This would explain some of the results obtained by De Prano and Mayer. The bias in this case reduces the correlation between C_t and A_t and in the extreme could make it a negative correlation.[24]

An attempt is made by Ando and Modigliani to derive a definition of autonomous expenditures by a thorough examination of the national income accounts. Although they do not perform the statistical test of their criterion for separating autonomous components from induced components, they feel that the definitions of the variables they arrive at are independent of the disturbance term in the equation they test. After making some simplifying assumptions, they arrive at the following definition.[25]

(2.13) A^* = Net investment in plant and equipment and in residential houses plus total government purchases of goods and services plus exports plus property tax portion of indirect business taxes plus net interest paid by government plus government transfer payments plus

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[24]Ando and Modigliani, <u>op. cit</u>., p. 699.

[25]<u>Ibid</u>., p. 702.

enterprises minus statistical discrepancy minus excess of wage accruals over disbursements.

Their definition differed from that used by Friedman and Meiselman because A* and consumption expenditures (C) do not aggregate to the total value of income. They felt it was necessary to alter the test somewhat, so they decided to run A* against the rest of income. This latter component of income was called induced expenditures and labeled C^f.

It becomes apparent in going through this debate that one major point about the appropriate definition for the model boils down to a discussion of time periods. Certain items should be considered autonomous if the time period under examination is of a certain length. If a shorter time period is chosen the item is induced. For example, Friedman and Meiselman feel that the deficit is autonomous for a period as long as one year. The government accounts must be balanced in this time period in terms of paying for its expenditures. In tests over shorter periods, they feel that perhaps the deficit is not autonomous because the government does not need to concern itself with balancing its accounts. Over this shorter length of time the level of government expenditures might be the autonomous component. Thus, the debate is reduced to the question of appropriate time periods. That is, over what time periods must tax collections be reconciled with expenditures? If one year is the correct time period, the Friedman-Meiselman concept is correct.

Minor Points of Discussion

Discussion of the time periods chosen

The different definitions of autonomous expenditures were tested in the three articles under review over the period 1929-1958 and 1929-1963. Hester used five subperiods in his testing, while the Ando-Modigliani and De Prano-Mayer tests were over the whole period. Ando and Modigliani also excluded the war years.

Hester found that, excluding the war years, the income-expenditure approach performed about as well as the quantity theory model in terms of the coefficient of correlation. In almost every case the variables defined by Hester did better than the one developed by Friedman and Meiselman. The same results were apparent when first differences were used.

De Prano and Mayer arrived at very similar results. Their tests included more postwar years and seem preferable to Hester's for that reason. From their tests excluding the war years, they conclude that since there is little difference between the income-expenditure model using their definitions and the quantity theory model, that both models do equally well in explaining movements in consumption.

In their tests, Ando and Modigliani found that A* performed better than A in terms of a higher coefficient of correlation. In reply, Friedman and Meiselman tested A* over shorter periods of time. However, the correlation coefficient between M and C was still larger than between A* and C, although the difference was negligible.

Friedman and Meiselman criticize all three papers for testing over a shorter time period than they did.[26] They feel that the data are available to all and that the tests should have been carried back further. Hester, and others, argue that 1929 is the earliest date in which one can obtain consistent government data. All other series are not consistent with these government estimates.

The problem of using such a short time period can be brought into focus by using Hester's tests. If one excludes the subperiods that include World War II, there exists only three samples and two of these include the depression, the time period in which the income-expenditure approach was formulated. This period has also shown the worst results for the Quantity Theory.

This problem of excluding the war years seems to be quite serious. It raises a question about changes in the structure of the economy. That is, did the war cause a shift in the structure or should the results obtained during the

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[26]For example, Friedman and Meiselman, "Reply to Donald Hester," op. cit., p. 369.

war years be consistent with those obtained in peacetime? This has been a frequent topic of discussion in econometric textbooks in reference to the specification of the consumption function. It seems very likely that the intercept or the slope of the consumption function, or both would change during the war years.

However, Friedman and Meiselman found that "(t)he results turned out to be so consistent, . . . that we had no occasion to discuss the results for other subperiods in detail: the peacetime subperiods alone gave the same results as did the subperiods including some war years."[27] That is, the Quantity Theory showed the same close relationship in wartime as it did in peacetime.

A failure to detect shifts in the structure of an economy has been found in other studies where a money supply model is used.[28] Although it might be expected on an

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[27]Friedman and Meiselman, "Reply to Ando and Modigliani and to DePrano and Mayer," The American Economic Review, LV (September 1965), p. 761.

[28]Leonall Anderson and Jerry Jordan, Appendix, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Review, Federal Reserve Bank of St. Louis, 50 (November 1968), p. 24. Tests of a simple forecasting model based upon a reduced form derived from the Quantity Theory show that the hypothesis that there was no structural shifts in the economy from 1947-1968 could not be rejected. See also, Edgar Feige, The Demand for Liquid Assets: A Temporal Cross-Section Analysis (Englewood Cliffs, New Jersey: Prentice-Hall, 1964). Feige states that he could find no evidence that would reject the hypothesis of a consistent structural relationship in the demand for demand deposits over the time period of 1949-1959, p. 24.

a priori basis that the structure of the economy has changed, the simple quantity theory model has failed to pick up this shift. This should lead one to question the theoretical constructs of the model. It is possible that the statistical properties inherent in the Quantity Theory model make it impossible to identify these shifts.

Discussion of the discriminatory power of the two models

Ando and Modigliani discuss this problem in the Appendix to their article.[29] In order to test the discriminatory power of the two models they set up a complete model and attempt to determine the conditions necessary for the "money only" theory to hold, and for the "effective demand" theory to hold. Also, they determine the conditions that need to be fulfilled for both theories to hold simultaneously. These conditions were then compared with the possible outcomes of the single equation test. They condluded that the two single equation models had no power of discrimination between the two theories. If one model turned out relatively more stable than the other, no real conclusion could be drawn because the results could be consistent with either the Quantity Theory approach or the income-expenditure approach.

Friedman and Meiselman concur with the discriminatory power of the tests, but still feel that comparing the relative stability of the two relations provides the answers to

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[29]Ando and Modigliani, *op. cit.*, pp. 716-725.

the questions they are posing. However, if the results are consistent with either of the two theories, then the relative tests point to little if anything at all.

Other specifications of the models

Ando and Modigliani feel that the consumption function has been misspecified.[30] They feel that very few economists use the consumption function proposed by Friedman and Meiselman, particularly Friedman himself. Consequently, they introduce a consumption function that incorporates a "permanent income" specification in the spirit of Friedman's earlier theoretical work. Thus, they feel the consumption equation should have the lagged endogenous variable, C_{t-1}, included. This, of course, violates the rules set up by Friedman and Meiselman.

Secondly, Ando and Modigliani develop a demand for money equation similar to that used by Friedman in earlier work.[31] This, of course, introduces a more complicated equation and leads to some change in the results. Ando and Modigliani contend fundamentally and properly that the CMC paper of Friedman and Meiselman fails to be consistent with previous theoretical knowledge and does not incorporate theoretical developments by the authors themselves.

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[30] *Ibid.*, p. 696 and p. 704.

[31] *Ibid.*, pp. 707-710.

A third point concerns the exogeniety of the money supply. Friedman and Meiselman contend that the direction of causation could be from income to the money supply. However, they draw upon earlier studies of monetary reforms and devaluations to imply that causation apparently runs the opposite way. Also, recent empirical work indicates that the money supply has a very low income elasticity.

Hester discusses this point in his paper but fails to perform any tests of the hypothesis. Ando and Modigliani also raise the point, and do make an attempt to test the possibility.[32] They specify a new variable, M*, which is the maximum amount of money that could be created by the commercial banking sector, given the amount of reserves supplied by the central banking system. This will always be larger than the actual money supply. They feel that it is this variable that should be entered into the quantity theory model because it represents the behavior of the monetary authorities.

This raises once again the question of the appropriate time period in defining the extent to which variables are exogenous or endogenous. Certainly in the short-run the money supply should be considered an endogenous variable and some other variable should be used to represent the behavior of the monetary authorities. Over a longer period

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[32]Ibid., pp. 711-714.

of time, however, the money supply can be controlled within limits. The variable which has a large measure of influence over the money supply and which is considered to be under the control of the central bank, would be the monetary base. Preliminary estimates indicate that the lag in the influence of the monetary base on the money supply is approximately six months and that the elasticity of the money supply with respect to the monetary base, adjusted for member bank borrowings, is about 0.75. This covers the period from the third quarter of 1953 to the fourth quarter of 1965. This implies that on a yearly basis the money supply can be sufficiently controlled by the monetary authorities so that it can be considered exogenous to the economic system. If one were to consider a quarterly model, the money supply should probably be considered to be endogenous because over this shorter time period the money supply is determined by the interaction of economic forces.

The introduction of M* lowers the correlation of a money supply measure with consumption expenditures when tested in the original model. However, when the more sophisticated demand for money model is used, the coefficient of correlation is the same as when the other measure is used, but the error variance is lowered. Ando and Modigliani conclude from this result that a large component of the money supply is induced and that it therefore introduces an upward bias in the correlation coefficient of the Quantity Theory model.

This upward bias is a result of the positive correlation of the money supply with monetary Gross National Product. An increase in this latter measure will increase the money supply (M) and also will increase consumption expenditures. M* need not change to arrive at this increase in M.

Discussion of a more complete model

DePrano and Mayer, and Ando and Modigliani both discuss the need for a more complete model. They both feel that the confines of the single-equation models are too restrictive. However, the strong evidence presented by Friedman and Meiselman had to be answered according to the ground rules set up in the original article. The overwhelming results had to be matched, bettered, or discredited.

It is particularly evident in the Ando-Modigliani article that the authors feel that the single-equation models are misrepresentations of the real world and in many respects are a waste of time. DePrano and Mayer also question whether the two single-equation models are even comparable. This presents the problem that if they are not then what two would be.

These two articles imply that more complete models represent a truer picture of the world. In such models the stock of money and autonomous expenditures are both important and they should both be included in attempts to explain income determination. Also, a more complete model allows one to look for more complex transmission processes, which are simply not identifiable in single-equation models.

Finally, the single-equation models do not include some recent theoretical developments. As has been mentioned above, neither the permanent income hypothesis nor recent advancements in the area of the demand for money have been included in the simple formulations.

Additional Work

Two additional papers will be discussed in this section. These are papers by Pesek[33] and by Kmenta and Smith.[34] They are later papers than the ones discussed above and they approach the subject in slightly different ways.

The article by Pesek is primarily concerned with the quality of the evidence used in the test of the two theories. Specifically, Pesek thinks the Friedman-Meiselman test sets up the Quantity Theory so it is difficult to reject, while DePrano and Mayer do the same thing for the income-expenditure approach.

In the case of Friedman and Meiselman, the method of regressing induced expenditures (consumption expenditures

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[33]Boris Pesek, "Money vs. Autonomous Expenditures: The Quality of the Evidence," Business Economics, III (Spring, 1968), pp. 27-34.

[34]Jan Kmenta and Paul Smith, "Autonomous Expenditures vs. Money Supply: An Application of Dynamic Multipliers," Econometrics Workshop Paper No. 6604, Michigan State University, February, 1967.

above) on money will not only compete favorably with the income-expenditure approach, but will show better results the higher the correlation between induced and antonomous expenditures. To see this, one may examine the two coefficients of correlation:

$$(2.14) \qquad r^2_{Y,M} = \frac{\text{cov }(Y,M)^2}{\text{var }Y \text{ var }M}$$

where Y = Friedman-Meiselman concept of income

M = money stock

$$(2.15) \qquad r^2_{C+I,M} = \frac{\text{cov }(C+I,M)^2}{\text{var }(C+I) \text{ var }M}$$

where C+I = induced expenditures

A = autonomous expenditures.

If cov (M, A) = 0, then cov (Y, M) = cov $(C+I, M)^2$ so that (2.14) and (2.15) have like numerators. Now, var Y = var (C+I) + var (A) + 2 cov (C+I, A) and var Y > var (C+I) if var (A) + 2 cov (C+I, A) > 0, which implies that 2 cov (C+I,A) > - var (A). If cov (C+I,A) > 0 then $r^2_{Y,M} < r^2_{C+I,M}$. The higher cov (C+I, A) the greater $r^2_{Y,M}$ will be. This is exactly what would happen if the income-expenditure approach obtains good results. It should be noted that Friedman and Meiselman report that results confirm $r^2_{Y,M} < r^2_{C+I,M}$. However, they use the permanent income theory to explain what has occurred.

DePrano and Mayer, on the other hand, specify their model so that a part of investment expenditures is induced. That is, they assume net private domestic investment is composed of fixed investment and inventory investment. Inventory investment is endogenous and thus is eliminated from the definition of autonomous expenditures. This violates the test because DePrano and Mayer now relate their measure of autonomous expenditures to just the consumption component. To be consistent, autonomous expenditures should be related to all of the induced component. This means that DePrano and Mayer are trying to relate autonomous expenditures with a smaller item than do Friedman and Meiselman.

Friedman and Meiselman avoid this pitfall because they use all of net private domestic investment in their definition. They are left only with consumption expenditures in the induced component. Inventory investment, therefore, is included in autonomous expenditures.

A second point of Pesek's concerns the theoretical problem of defining autonomous expenditures. He feels that induced expenditures are a theoretically sound concept, but that perhaps autonomous component should be divided into two parts. One part would consist of private expenditures such as business investment, while the other part would be made up of public expenditures, such as government expenditures. This latter concept is the only one that would be directly comparable to a theoretical policy variable such as the money supply.

Two additional points are raised concerning the definition of the money supply. The first of these implies a bias introduced into the tests by the definition of M chosen by Friedman and Meiselman. The measure chosen to represent the money supply is relatively interest inelastic. By using this measure they have arrived at a value that will cause the LM curve of the familiar Hicks-Hansen IS-LM function to be almost vertical. This means that the only way income could change is by a monetary policy that shifted the LM function.

Since this is true, then any correlation between this measure of the money supply and income will be quite high. Therefore, defining variables empirically, as Friedman and Meiselman do, would lead them to choose this particular measure. Consequently, their conclusions are preordained.

The theoretical definition of the money supply also is questioned by Pesek. "Close substitutes" are defined in terms of cross-elasticities. In attempting to test definitions the way Friedman and Meiselman do, the more economically valid test is ignored.

Thus, Pesek concludes that the definitions and tests bias the results against the income-expenditure approach in favor of the Quantity Theory approach. But this is really secondary because he feels that these single-equation tests are out of date and that more attention should be paid to more complete theories in which both monetary and fiscal policies are important. In this way economists can learn more about the behavior of the economy and proper policy mixes.

The final paper discussed here takes the controversy into a full econometric model. Kmenta and Smith feel that it is necessary to combine the two theories and attempt to discover their relative importance in terms of the impact they have in the current time period and also the effect they have on an economy over time. They attempt to do this in a quarterly econometric model.

This is a very desirable direction in which to take the discussion. Since the paper is only a beginning attempt to assess the relative importance of the money supply and autonomous expenditures, this thesis will discuss only the important features of the model and some of the conclusions that were drawn from the work.

The money supply and government expenditures were taken as the exogenous elements or policy variables. Kmenta and Smith discussed the possibility that these might not be truly exogenous, but decided that, at the present stage of the investigation, they would assume them to be under the complete control of the proper authorities.

They engage in no discussion whatsoever of the proper definitions. One reason why so little attention was paid to the definition problem is that the more disaggregated a model becomes, the smaller the definitional problem becomes.

Two developments should be noted, however. First, government expenditures include net foreign investment.

Consequently, this variable is not completely under the control of the government. Also, some parts of government expenditures might be considered endogenous in a quarterly model. Secondly, taxes are excluded altogether. Autonomous expenditures are government expenditures plus the net foreign balance. The deficit problem is eliminated because taxes are eliminated. Net private domestic investment, in a larger model, such as this, becomes determined within the system.

Estimates were obtained for the whole system using two-stage least squares. Variables whose coefficients were not significantly different from zero were retained. This has been fairly common practice as can be noted in the literature of the field and it occurs because econometricians are generally interested in the behavior of the whole system over time. Even though these variables are not significant in a statistical sense, they do contribute to the understanding of this system.

The tentative conclusions drawn by Kmenta and Smith were that there is little to differentiate between the effects of autonomous expenditures and the money supply. This is not inconsistent with the battery of tests performed by Ando and Modigliani, DePrano and Mayer, and Hester. Also, the "long-run" multipliers of the two policy variables are lower than usually obtained in tests on static models such as the ones mentioned above.

Summary

A few things are implied in all of the above discussion. Firstly, a great deal depends on the definitions one chooses for the relevant variables. Secondly, most researchers are uncomfortable using the simple one-equation models. Thirdly, most feel that both the money supply and autonomous expenditures are important in determining aggregate income, but there is a significant area of theoretical disagreement and empirical ignorance concerning which of the two may be the more important. Consequently, in the following chapter a macroeconometric model that is theoretically more completely specified than those used in previous investigations will be developed. This model will subsequently be implemented in an effort to shed new evidence on the question of the relative importance of autonomous expenditures versus the money supply as determinants of aggregate economic activity.

CHAPTER III

A DISCUSSION OF FURTHER TESTS

Introduction

Friedman and Meiselman set out to test two simple models of income-determination. The explicit purpose of their test was to determine which variable, the money stock or autonomous expenditures, was more closely related to movements in income. They were not specifically concerned about causation; nevertheless, inferences were drawn, linking this study with other studies that have been completed, particularly those of Friedman.

The two models tested were supposed to represent the simplest forms of the two theories. However, there is a great deal of ambiguity in the point of view that one theory is as simple as another, and that the results obtained in testing them are comparable. Be that as it may, these models were felt to be a desirable starting place for testing which variable moves more closely with some measure of income.

The two simple models do represent testable hypotheses about the structure of the economy. However, it is possible that the two models are so highly aggregated and simplified that they might actually offer little power for discriminating among alternative hypotheses concerning the structure of the economy. Simple models such as these depend quite heavily upon the definitions of the several variables. As was mentioned in Chapter II, much of the earlier debate centered on the definitional specification of the models. One could therefore question the validity of the results, because quite different conclusions might be reached by only a slight change in the definition of any of the variables used.

This thesis will rely primarily on definitions that result from _a priori_ theory. There are certain elements of arbitrariness in this method, but there are also elements of arbitrariness in defining varibles empirically. By contrast, Friedman and Meiselman contend that the use of intuition or _a priori_ guessing is not a scientifically valid method. They contend that the empirical method is the only "objective way" to define variables consistently.[1]

Deriving definitions theoretically, however, is a valid method. All scientific researchers must use their intuition to some extent in order to establish theoretical concepts. These concepts can be used to construct theoretical structures that can be tested. The scientific method requires only that

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[1]Friedman and Meiselman, "Reply to Ando and Modigliani and to DePrano and Mayer," _The American Economic Review_, LV (September, 1965), p. 764.

the researcher set up his assumptions (which also include his definitions), state his hypothesis (which is possible to refute) and then follow procedures which can be duplicated. The ability of a test to be duplicated is the backbone of experimental science. How the assumptions are determined in many cases is arbitrary--one set is unacceptable only in the face of an alternative body of assumptions that are more acceptable in terms of framing a hypothesis.

The effort of Friedman and Meiselman to define variables empirically appears to set back the formulation of assumptions and tests one step. They still proceed along the same lines as others, using their intuition and/or theory, but one step removed from defining the variables, theoretically. Consequently, it is argued that one method is as valid as the other.

It would also appear that if economic analysis is to have any relevance as a "science" that an analyst should be capable of defining variables by the logical application of its methods. This must assume, of course, a given level of aggregation. In the following, the definitions developed by Friedman and Meiselman and by Hester will be used in retesting their own models. Further developments, however, will be made along the lines discussed above. The various functional forms have been developed using the tools of analysis available. The variables have been defined in a manner that enables the two theories to be tested.

In the second section of this Chapter, the Friedman-Meiselman models will be specified again in order to rerun the original data and also to perhaps correct it for some statistical deficiencies. In the third section, Hester's model will be developed so that it can be used as an alternative hypothesis when testing the two F-M models over a more current period. In the fourth section, a complete model will be specified. This is necessary for three reasons. It is readily apparent that the more one aggregates an econometric model, the greater the problem of definition becomes, and hence the greater is the need for careful specification. The second reason is that much of the disagreement between the two schools of economic thought is caused by the failure of many monetary economists to specify or to derive the transmission process by which changes in the financial sector are transferred to the real sector. Ando and Modigliani make specific reference to this matter[2] while Harry G. Johnson has stated that the results of Friedman and Meiselman

> . . . pose an important theoretical problem since they imply that a change in the quantity of money that has no wealth-effect nevertheless will have an effect on consumption even though it has no effect on interest rates. The difficulty of understanding how this can be prompted the dissatisfaction of Keynes, Wicksell and other income-expenditure theorists with the quantity theory, and provides the hard core of contemporary resistance to it.[3]

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[2]Albert Ando and Franco Modigliani, "The Relative Stability of Monetary Velocity and the Investment Multiplier," The American Economic Review, LV (September, 1965), p. 716.

[3]Harry G. Johnson, "Monetary Theory and Policy," The American Economic Review, LII (June, 1962), p. 357.

In the complete model developed here, the transmission processes are explicitly articulated and are consequently susceptable to empirical test. Finally, the model introduces dynamic elements. Modern economic models have shown that the impact effects of changes in exogenous variables are considerably different than the total effects achieved over time. These modern methods might shed some additional light on the relative importance of the two theories.

Friedman-Meiselman Hypothesis

Friedman and Meiselman develop their "reduced form" models from very rudimentary examples of the income-expenditure and quantity-theory models.

The development of the income-expenditure model is as follows:

(3.1) $$Y_t = C_t + A_t$$

where Y_t = income in current dollars

C_t = all induced expenditures in current dollars

A_t = all autonomous expenditures in current dollars

(3.2) $$C_t = a + bY_t + u_1$$

(3.3) $$A_t = \overline{A}_t$$

from which the following is obtained:

(3.4) $$C_t = \alpha + \beta A_t + u_2$$

where $\alpha = \frac{a}{1-b}$

and $\beta = \frac{b}{1-b}$

u_1 and u_2 are normal stochastic error terms with zero mean, constant variance, and zero covariance.

The Quantity Theory model is developed along similar lines:

(3.5) $$C_t = a + bY_t + u_1$$

(3.6) $$Y_t = V'M$$

from which the following is obtained:

(3.7) $$C_t = \alpha + VM_t + u_3$$

where $\alpha = a$

and $V = V'b$

M_t = money stock (defined by F-M as coin and currency in hands of nonbank public and all commercial bank deposits).

u_3 = normal stochastic error term with zero mean, constant variance and zero covariance.

Each equation allegedly represents the reduced form of a system of simultaneous equations. In addition, they are identified and can be estimated by the method of ordinary least squares. The estimates will be unbiased, consistent and most efficient among all unbiased estimators. The test of significance will therefore be statistically valid, given the stringent assumptions of the models.

It has been mentioned before that the systems of equations chosen are ambiguous from several points of view. In the first place the two sets of equations are not mutually exclusive.[4] In constructing them in this way, part of our knowledge is not utilized because other important theoretical and empirical relationships are ignored or passed over. The influence of the monetary variables on the various components of autonomous expenditures are left out, for instance. Secondly, they are deceptively and, in fact undesirably simple. For example, the consumption function in (3.2) and (3.5) is used by very few economists in the face of recent advances in the science, particularly those of Friedman and Dusenberry.[5] Thirdly, there are probably some endogenous components on the right hand side of the equations that tend to bias the estimated regression coefficients, upward for the Quantity Theory equation and downwards for the income-expenditure model. In this sense the equations (3.4) and (3.7) cannot properly

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[4]See Appendix to Albert Ando and Franco Modigliani, "The Relative Stability of Monetary Velocity and the Investment Multiplier," The American Economic Review, LV (September, 1965), pp. 716-722.

[5]Milton Friedman, A Theory of the Consumption Function (Princeton University Press, 1957), and James Duesenberry, Income, Saving and the Theory of Consumer Behavior (Harvard University Press, 1949).

be regarded as reduced forms. Finally, in the face of the additional knowledge available in the field, each model is misspecified. Hence, there are some difficulties in statistical estimation. These last two points will be discussed more thoroughly in Chapter IV, where empirical tests are reported.

In testing these versions of the two theories, two definitions of the money supply will be used. The first is coin and currency in the hands of the nonbank public and demand deposits at commercial banks; the second is the definition of the money stock presented above, which was used by Friedman and Meiselman.

The definition of autonomous expenditures (A) is developed in the following way:

$$GNP_t = C_t + GPDI_t + G_t + E_t - O_t \tag{3.8}$$

where GNP_t = Gross National Product in current dollars

C_t = consumption expenditures in current dollars

$GPDI_t$ = gross private domestic investment in current dollars

G_t = government expenditures on goods and services in current dollars

E_t = exports in current dollars

O_t = imports in current dollars

Equation (3.8) is altered in the following way:

$$(3.9)\quad GNP_t - D_t - T_t = C_t + GPDI_t - D_t + G_t - T_t + E_t - O_t$$
$$= C_t + NPDI_t + (G_t - T_t) + (E_t - O_t)$$
$$= C_t + A_t$$

where D_t = depreciation in current dollars

T_t = net taxes and transfers in current dollars

$NPDI_t$ = net private domestic investment in current dollars

$G_t - T_t$ = government deficit in current dollars

$E_t - O_t$ = net foreign balance in current dollars

The income total used by Friedman and Meiselman is that value on the left hand side of (3.9). It is the sum of incomes on an accrued basis and not those actually received. In order to compare the simple income-expenditure approach with the simple quantity theory approach both equations tested must have the same dependent variable. Consequently, the Quantity Theory equation is altered in the following way:

$$(3.10)\quad GNP_t - D_t - T_t = \alpha + VM_t$$

It should be noted that the velocity and multiplier relations derived here are marginal values, whereas most derivations of the Quantity Theory work with average values, because it is assumed that the marginal and average are the same.

In order to present tests of the possibility of hidden influence (or joint explanation by A and M) as discussed in Chapter II it will be necessary to also test

$$(3.11) \qquad C_t = \alpha + \beta A_t + VM_t + u_4$$

Hester's Developments

Hester developed his model in a way that is very similar to that of Friedman and Meiselman. He does not quarrel with the Quantity Theory approach used, and therefore deals solely with the income-expenditure approach. Using the symbols of the second section of this chapter, Hester defines income as:

$$(3.12) \qquad GNP_t - D_t = C_t + (GPDI_t - D_t) + G_t + E_t - O_t$$

$$= C_t + L_t$$

where L_t = autonomous expenditures and in this instance include net private domestic investment, total government expenditures, and the net foreign balance. Alterations are made in this definition as Hester varies the items he considers to be endogenous and that should not be included in the total of autonomous expenditures. In particular, L_t' is the same as L_t, only imports (O_t) are eliminated and depreciation (D_t) is added back into the total. L_t'', is the same as L_t' but imports (O_t) are taken out and depreciation is left in. L_t''' is the same as L_t' except that inventory investment is removed.
The definition of consumption should be adjusted to take into

account the various changes in the definition of autonomous expenditures. Using one of these four definitions, Hester tested the following equation:

$$C_t = \alpha_1 + \beta_1 L_t + u_5 \tag{3.13}$$

where u_5 = normal stochastic error term satisfying all the normal assumptions of zero mean, constant variance, and zero covariance.

The reduced form for consumption will be tested over recent data and compared directly with the result of the test of the Friedman-Meiselman model over the same time period. One of the primary purposes of testing the two formulations over the same time period is to show the effects of the differences in the definitions of autonomous expenditures.

A Complete Econometric Model

In order to perform additional tests concerning the relative stability of the multiplier and the velocity of circulation, it is necessary to develop a more complex model. A less aggregated model will encounter fewer difficulties with problems of definition. An attempt can also be made with a more complete model to identify the transmission processes from the financial sector to the real sector and from the real sector back to the financial sector. Also, dynamic elements can be introduced into the model which can lead to a study of the behavior of the system over time. The more complete model can also provide additional information concerning shifts in the structure of the economy. As Friedman and Meiselman have noted, a reduced form cannot take account of such shifts that occur within the complete model. These represent just a few directions a researcher can follow in order to test the two theoretical models more thoroughly.

In the following model, use will be made of the definitions listed below:

Y_t = Gross National Product

C_t = consumption expenditures

I_t = gross private domestic investment

G_t = total government expenditures on goods and services

E_t = exports

O_t = imports

Y_t^d = disposable income

M_t = money stock (coin and currency in the hands of the nonbank public plus adjusted demand deposits in commercial banks)

r_t^s = interest rate on three-month U. S. Treasury bills

r_t^1 = interest rate on U. S. Treasury bonds

B_t = adjusted monetary base

r_t^d = rediscount rate

t = time trend, quarterly, $t = 1$ on 1953-III

All data are quarterly, current dollar and seasonally adjusted. The subscript t, refers to the current quarter. The data cover the period from the third quarter of 1953 to the fourth quarter of 1965.

$$(3.14) \qquad Y_t = C_t + I_t + G_t + E_t - O_t$$

$$(3.15) \qquad C_t = \alpha_o + \alpha_1 Y_t^d + \alpha_2 C_{t-1} + \alpha_3 M_t - \alpha_4 M_{t-1} + u_{1t}$$

$$(3.16) \qquad I_t = \beta_o + \beta_1 (C_{t-1} - C_{t-2}) + \beta_2 Y_t + \beta_3 r_t^l + \beta_4 t + u_{2t}$$

$$(3.17) \qquad Y_t^d = \gamma_o + \gamma_1 Y_t + u_{3t}$$

$$(3.18) \qquad O_t = \eta_o + \eta_1 Y_t + u_{4t}$$

$$(3.19) \qquad r_t^l = \varepsilon_o + \varepsilon_1 r_t^s + \varepsilon_2 Y_t + u_{5t}$$

$$(3.20) \qquad r_t^s = \lambda_o + \lambda_1 Y_t + \lambda_2 M_t^d + u_{6t}$$

$$(3.21) \qquad M_t^s = \delta_o + \delta_1 r_t^s + \delta_2 r_t^d + \delta_3 B_t + u_{7t}$$

$$(3.22) \qquad M_t^s = M_t^d = M_t$$

The exogenous variables are G_t, E_t, r_t^d, and B_t. The u_{it} represent disturbance terms that are assumed to have a normal distribution, zero mean, constant variance and zero covariance.

The consumption function (3.19) is derived from the permanent income hypothesis in which consumption expenditures are based upon the expected permanent disposable income of the individual rather than upon current disposable income.

This seems to be an improvement over the one used in (3.2) and (3.5) for it takes account of the whole spectrum of a consumer's horizon and can account for shifts in the short-run consumption function that cannot be accounted for in the simpler model of income determination.[6] Money balances are included as an argument in the consumption function.

The following is the original form of the consumption function:

$$(3.23) \qquad C_t = a_o + a_1 Y_t^{pd} + a_2 M_t$$

where Y_t^{pd} is permanent disposable income, which is estimated as:

$$(3.24) \qquad Y_t^{pd} = bY_t^d + b^2 Y_{t-1}^d + \ldots + b^n Y_{t-n-1}^d + \ldots$$

where $0 < b < 1$. Substituting this into (3.23) and applying Koyck's transformation and then adding a disturbance term, we get equation (3.15).

Some economists have found liquid assets or money balances to be significant in the specification of a consumption function.[7] Since the model is formulated in terms of

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[6]Shifts in the simple consumption function generally come from autonomous movements in the intercept term a. In the more sophisticated consumption function there can be changes in the expected flow of income, which would offset the whole consumption function, even though the relationship with current income is not changed.

[7]For example, see A. Zellner, D. S. Huang and L. C. Chau, "Further Analysis of the Short-run Consumption Function with Emphasis on the Role of Liquid Assets," Econometrica, Vol. 33 (July, 1965), pp. 571-581.

nominal values, this is not quite the same as a real balance effect. A statistically significant coefficient for M would indicate the importance of this variable but this result may or may not be a result of the real balance effect. Some economists do not consider an increase in money as an increase in monetary wealth.[8] They do, however, regard it as an increase in the liquidity of the economy, which would have some effect on consumer expenditures. Therefore, the money stock will serve as a proxy for liquid assets. Other economists feel that the money supply is a component of wealth and changes in this variable result in direct changes in monetary wealth.[9] In any event, the inclusion of liquid assets can be justified using several theoretical approaches.

Changes in the money stock could affect expenditure decisions in two ways. First, an increase could increase the wealth of the economic unit and, with interest rates held constant, could increase imputed income, and, therefore, consumption. Secondly, the increase could cause a portfolio effect because, assuming equilibrium in the consumer's balance sheet before the change in money balances, there would be more money now relative to other assets. This would imply

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[8]For example, see James Tobin, "An Essay on Principles of Debt Management," in B. Fox and E. Shapiro, Fiscal and Debt Management Policies (Englewood Cliffs, New Jersey: Prentice-Hall, 1963), p. 148.

[9]Boris P. Pesek and Thomas R. Saving, Money, Wealth, and Economic Theory (New York: The Macmillan Co., 1967).

that other uses of the unit's assets would provide the consumer with a greater return. If one or both of these effects were to occur it would tend to alter behavior leading to an adjustment of the portfolio and a purchase of alternative assets. The economic unit would tend to buy more financial assets, more durable goods, and more nondurable goods, in an effort to return to an equilibrium position. This would be achieved when the rate of return on each type of asset, for a given risk class, is the same. A change in wealth, although it is not included explicitly here, which caused a wealth effect, could take place with no change in interest rates or it could take place with a change in interest rates and no change in expected income.

In light of the quotation made by H. G. Johnson above, the testing of an equation such as this could help to determine whether the wealth effect, as supported by Milton Friedman, does actually occur and whether the transmission from monetary variables to real variables can take place in the consumer sectors. However, it is doubtful whether this particular form of the consumption function can discriminate between the quantity theorists and the economists who advance the liquidity preference theory. If α_3 and/or α_4 are significant and possess the correct signs, then this is actually consistent with both theories.

Investment expenditures, in this model, are determined by the level of income, the level of interest rates, and the change in consumption expenditures. The level of income acts as an inducement to invest. It would be expected that businessmen would be influenced not only by how fast sales are increasing but also by the level of income and output. Whereas business firms base their planned expenditures on the expected future level of receipts, investment demand would be influenced by the level of economic activity. The level of income is thus expected to help explain aggregate investment demand.

Since future receipts are unknown, particularly for the economy as a whole, a variable is needed to reflect the direction of these future receipts and also the rate at which they are changing. The change in consumption expenditures provides a proxy. Changes in sales also provide some information on the unintended accumulation or depletion of inventories. Changes in consumption expenditures seem to be a better indicator of future receipts than changes in physical output. This is because changes in consumption expenditures are more closely linked to the future receipts of final sales and through them exert a pull on future receipts of all other types of expenditures.

The level of interest rates represents to some extent the cost of capital to business and thus is a vital figure in investment decisions. The time trend, t, is included in the investment function to allow for induced technological progress.

Government expenditures are assumed to be exogenous inasmuch as the level of these expenditures is determined outside of the system. There appears to be little or no induced component in government expenditures, for these are based more upon political considerations than the current level of activity in the economy.

Tax collections and transfer payments present a different situation. In the long run, these items could be considered exogenous to the system. Theoretically any level of the collections of payments could be obtained if the political units that had responsibility for levying taxes maneuvered tax rates which are totally exogenous so as to achieve their desired goal. This would imply that the political unit possessed the necessary information about the economy in order to adjust tax rates instantaneously to obtain the desired tax aggregates. In turn this would imply that the political unit had sufficient knowledge of the structure of the economy. That is, they have an adequate model which represents the economy and have knowledge of the structural parameters so that any adjustment they make would have the predicted effect. It is generally believed that these conditions are not met. The political units seem to possess fairly wide latitude to set tax rates and to determine the structure of tax collections, but they do not have the necessary information concerning present and future changes in the economy, nor the knowledge of the structure of the economy, nor the capability of adjusting the tax structure instantaneously. Once a given tax structure is determined, actual tax collections clearly depend upon the level of economic activity, at least in the short run: as the level of activity rises, tax collections rise.

A related problem is that the government has a budget restraint in the longer run.[10] That is, it must finance a deficit in one of three ways. It must collect taxes, make additions to the monetary base by either the printing press or selling bonds to the central banks, or by selling bonds to the private sector of the economy. This can be formulated as follows:

$$G_t = T_t + \Delta B_t + X_t \tag{3.25}$$

where T_t = taxes collected

ΔB_t = change in the monetary base

X_t = new Government issues sold to private sector

Only three of these are independent. The fourth must be endogenous. Consequently, in the longer run, it might be necessary to consider the financing of the Government's

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[10] Carl F. Christ, "A Short-run Aggregate-demand Model of the Interdependence and Effects of Monetary and Fiscal Policies with Keynesian and Classical Interest Elasticities," The American Economic Review, Vol. LVII (May 1967), pp. 434-443 and Carl F. Christ, "A Simple Macroeconomic Model with a Government Budget Restraint," The Journal of Political Economy, Vol. 76 (January-February 1968), pp. 53-67.

deficit. This is the conclusion drawn by Friedman and Meiselman for a period as long as one year.

In the short run, however, this is not a necessary condition. That is, several of the decisions are determined endogenously. For example, tax payments are made at the initiative of the tax payer, if he pays before a given tax date. Whereas, over the whole year taxes may be exogenously determined, in one quarter they are not. Also, the distribution of the deficit between B and X may not be explicitly determined in any one quarter, whereas over the full year it must be.

Therefore, in a quarterly model, such as the present one, it will be assumed that only Government expenditures are exogenous. This is consistent with the belief Friedman and Meiselman have expressed that Government expenditures and not the Government deficit is the relevant variable for a short-run model.[11]

The development of equation (3.17) is as follows:

$$(3.26) \qquad Y^d_t = Y_t - T_x + T_r - D - CP - SI - IV$$

where T_x = taxes

T_r = transfer payments

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[11]Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in B. Fox and E. Shapiro, <u>Stabilization Policies</u> (Englewood Cliffs, New Jersey: Prentice-Hall, 1963), p. 204.

D = depreciation

CP = corporate profits

SI = social insurance collections

IV = inventory evaluation

Since all these variables are taken to be endogenously determined in the short run, they can be assumed to be a function of the current level of Gross National Product. Consequently, (3.26) can be reduced to (3.17) by

$$(3.27) \qquad Y_t^d = Y_t + f(Y_t) = \gamma_o + \gamma_1 Y_t$$

Exports are considered to be exogenous because the decision to purchase goods from the economic system under consideration are based upon variables that are determined primarily outside of this system. Imports, in the short run, are determined within the system. Over time imports must equal exports. That is, a country must pay, in terms of exports, for the goods it purchases from other countries. In the short run this is not necessary. Therefore, it is generally considered that in a quarterly model, increases in income will lead to increases in imports.

Equation (3.19) represents the term structure of interest rates. As expressed, the long-term rate, in this instance the rate on long-term U. S. Treasury bonds, is a function of the three-month U. S. Treasury bill rate and the current level of GNP. The short-term rate is partially determined in the money demand and supply equations to be discussed below. The primary movements in the short-term rate represent changes in monetary variables. The current level of GNP also affects the long-term interest rate positively. An increase in economic activity will increase the demand for loanable funds, which will cause upward pressure on the long-term interest rate. In a rough way, current dollar GNP is a proxy for the influence of productivity on interest rates as espoused by neoclassical economists.

Money consists of coin and currency in the hands of the nonbank public and adjusted demand deposits at commercial banks. The primary function of money is to serve as a medium of exchange. No other asset, at the present time, fulfills this function.[12] Money can serve as a store of value, and certainly does provide this service to economic units holding assets in this form. However, money derives its function as a store of value by virtue of its function as a medium of exchange. Any broader definition of money obtained by *a priori* reasoning or by empirical tests can result only in an arbitrary listing of assets, which could be extended indefinitely.

It is also true that any other listing of assets would give money the property of being relatively more interest inelastic. Any variation in interest rates would lead to

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[12]Pesek and Saving feel that Traveler's checks should be included in this category. See *op. cit.*, p. 253.

relatively smaller changes in individuals' demand for money. Such a definition of money would bias empirical results in favor of a theory which favored the use of the quantity of money in circulation.[13] In the familiar Hicks-Hansen IS-LM formulation, it would result in the LM curve being fixed at one level of income. Changes in the money supply would be the only way for an economy to alter its level of activity.

The demand for money (in this instance the interest rate determination function) is taken as a function of current income and the current level of interest rates. The form presented in (3.20) is necessary for testing purposes and can be interpreted in either of two ways. Representing the demand for money as an asset the equation shows interest rates as the opportunity cost of holding money. The higher the rate of interest, the greater the cost of holding any given amount of money. The level of current income affects the transactions that individuals wish to undertake. A rise in income will increase the demand for money at each interest rate.

A second way of interpreting equation (3.20) is to show that the level of interest rates is determined by influences from both the real sector and the financial sector. Whereas, an increase in the money supply would increase loanable funds, for a given level of income and consequently lower interest

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[13]Boris P. Pesek, "Money versus Autonomous Expenditures: The Quality of the Evidence," Business Economics, III (Spring 1968), pp. 29-30.

rates, and increase in income, for a given level of the money stock, would raise interest rates by increasing the demand for loanable funds.

The money supply represents a problem similar to that of tax collections and transfer payments. Theoretically, it could be set at any desired level by the central banking authorities, and thus could be considered an exogenous variable. Yet for pure exogeniety, the central banking authority must have knowledge of the economic structure and of the way in which the policy variables over which it has control work through the structure. The banking authority must also be able to predict what will occur as changes in these variables take place. These conditions, as in the case of tax collections, are generally not met.

A useful way to develop a money supply model is as follows. The money supply is defined as:

(3.28) $$M_t = C_t + D_t$$

where C_t = coin and currency in the hands of the nonbank public

D_t = adjusted demand deposits at commercial banks

The adjusted monetary base is:

(3.29) $$B_t = C_t + R_t$$

where R_t = total bank reserves less member bank borrowing

Dividing (3.28) by (3.29) and rearranging, we get:

$$(3.30) \qquad M_t = \frac{B_t}{\dfrac{C_t}{D_t} + \dfrac{R_t}{D_t}}$$

where C_t/D_t is called the currency-deposit ratio and R_t/D_t is called the reserve-deposit ratio. As it now stands (3.30) is an identity. However, behavioral relations can be introduced that can transfer the equation into a stochastic equation.

C_t/D_t can be affected by many things. As yet, however, it has been difficult to quantify the determinants of this behavioral relationship. One could assume, for instance, that this ratio will tend to be lower when the economy is very active. Since interest rates usually rise in periods of high activity, interest rates could be used as an explanatory variable in a behavioral equation. This is a tenuous conclusion and, therefore, will not be relied upon. A closer relationship can be derived in the case of the reserve-deposit ratio.

The reserve-deposit ratio tends to fall as interest rates rise. Teigen feels that the relevant variable in a money supply function is the difference between some interest rate and the rediscount rate.[14] As the spread increases,

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[14]Ronald L. Teigen, "The Demand for and Supply of Money," in W. L. Smith and R. L. Teigen, <u>Readings in Money, National Income, and Stabilization Policy</u> (Homewood, Ill.: Richard D. Irwin, 1965), p. 62.

banks squeeze their excess reserves, and so for a given level of the adjusted monetary base the money supply will be larger. Since the interest rate may also affect the currency-deposit ratio the equation tested will use the level of an interest rate and the level of the rediscount rate, rather than their difference. The hypothesis that the difference matters rather than the level can be tested from the form of equation (3.21). If δ_1 and δ_2 are not significantly different from one another in absolute value but do possess opposite signs, this would tend to support the hypothesis that the difference could be used rather than levels. Three-month Treasury bills are used as a proxy for other interest rates because, being short-term and generally risk free, they represent the anchor of the whole spectrum of interest rates.

The adjusted monetary base is assumed to be the variable truly under the control of the central banking authorities. Member bank borrowings are excluded from the base because they are undertaken at the initiative of commercial banks and not at the initiative of the central bank. Consequently, since commercial banks supposedly have a reluctance to borrow at the central bank, they will adjust their behavior to non-borrowed reserves rather than total reserves. The rest of the base is determined at the will of the monetary authorities. They determine how the base is used even though the source of the base represents some endogenous components.[15]

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[15]Karl Brunner and Allan H. Meltzer, "Rejoinder to Chase and Hendershott," in G. Horwich, Monetary Process and Policy: A Symposium (Homewood, Ill.: Richard D. Irwin, 1967), p. 377.

Therefore, the adjusted monetary base and the rediscount rate will be taken as the variables that are truly exogenous and representative of monetary policy in the short run.

CHAPTER IV

ADDITIONAL TESTS OF VARIOUS SINGLE-EQUATION SPECIFICATIONS

Introduction

Although the discussion of the Friedman-Meiselman work has covered a wide range of topics, several additional areas need to be explored in greater depth. This chapter attempts to go into these areas. Also, a few topics, which have been discussed earlier, such as the problem of simultaneous equation bias, will be brought up again. Most, however, have either been ignored or forgotten, such as the problem of autocorrelation and the use of the narrow measure of the money supply.

Results are presented which provide tests for the same period used in computing the complete model developed in Chapter III. This can allow for the comparison of the results of the full model with the naive models.

Tests Concerning the Friedman-Meiselman Hypothesis

General problems

In the process of recalculating regressions using the Friedman-Meiselman data, two omissions on their part became quite evident. The first pertains to the reporting of the data, while the second pertains to the data itself.

In the first place standard errors are reported for exogenous variables only in equations where more than one variable is being tested. This would seem to imply that the variable in question always had a coefficient that was significantly different than zero. However, this is not quite the case.

In discussing this point, the autonomous expenditures variable will be examined. Thirteen regressions are run where consumption expenditures (C) is regressed just on autonomous expenditures (A), using annual data. Of these, the coefficient of autonomous expenditures is not significantly different from zero at a 5% level of significance in four instances. Therefore the coefficient for autonomous expenditures is not significantly different from zero roughly one-third of the time.

A frequently encountered problem which relates to the value of the standard error is autocorrelation. If autocorrelation is present in any equation, the use of ordinary least squares will provide estimates that are inefficient, and in addition the computed standard errors will be biased downward. All thirteen equations show evidence of autocorrelation at the 5% level of significance. This means that the true standard errors are underestimated. If this is the case, there exists strong possibility that several more coefficients are insignificant. Results presented in Appendix A show the effects of one method of correction for autocorrelation in these regressions. From these results it appears that in over half of the equations tested, the coefficient of the Friedman-Meiselman definition of autonomous expenditures, where used as an explanatory variable for consumption expenditures, is not significant. The failure to publish standard errors certainly leads to a false impression as to the importance of the autonomous variable. It also leads to some question concerning the definition used and also the ability of the definitional test proposed by Friedman and Meiselman to discriminate correctly the relevant components of a variable.

These results, however, carry over to all the regressions. In total, fifty-two regressions are run in which autonomous expenditures is a regressor, either separately or combined with other explanatory variables. In thirty-three of these fifty-two runs the coefficient of autonomous expenditures has either the wrong sign or has a coefficient that is not significantly different from zero or both. Again, autocorrelation is present in most cases and if the equations are corrected for its presence there is strong possibility that several more coefficients will be insignificant. This would mean that the Friedman-Meiselman concept would either be not significantly different from zero or possess the wrong sign in about seventy-five per cent of the time periods tested. It is questionable whether this equation is capable of being compared with the money supply equation.

In the case of the money supply, the coefficient is not significantly different from zero only ten times out of the seventy-eight periods tested. The standard error was corrected for autocorrelation in these equations also. The results are presented in Appendix A. The number of insignificant coefficients increase somewhat but are still approximately only 15 per cent of the cases. Thus, it appears that Friedman and Meiselman test a variable that is of significant value most of the time against a variable that is insignificant most of the time.

The other difficulty is that different data were used over the time period of the study. The regressions up to and including 1929 use a different set of data than those used in the regressions from 1929 to 1958. In the former, consumption outlays were taken from unpublished figures developed by Kuznets for the National Bureau of Economic Research. Autonomous expenditures were computed from Raymond Goldsmith's A Study of Saving (Vol. I). Data for the 1946-55 period came from the Survey of Current Business (July 1959). The money supply figures came from data developed by Friedman and Schwartz for the National Bureau of Economic Research. The implicit price deflator for consumer outlays came from Kuznets.

For the regressions covering the period from 1929-1958 a different set of data were used. Consumption expenditures came from the Survey of Current Business (July 1959).

Autonomous expenditures came from the 1954 edition of National Income and also the Survey of Current Business (July 1959). Money supply data came from Friedman and Schwartz. The implicit price deflator of personal consumption expenditures for the Department of Commerce came from the 1958 edition of U. S. Income and Output supplemented by the Survey of Current Business (July 1959).

It is understandable that more than one source of data would be used in compiling a long time series such as the one under review here. It would appear more appropriate, however, if tests had been reported for the complete series of 1897 to 1958 and the Commerce series of 1929-1958. Although this may cause only little difference in the reported regressions, Friedman and Meiselman give no indication that the results have been derived from two sets of data.

Definitional tests

The test used by Friedman and Meiselman to determine the composition of the money supply and autonomous expenditures has caused a considerable amount of discussion. This test appears to be of doubtful validity. It was assumed (see above pages 21-24), that if an item was autonomous, that a shift of one dollar between this item and other autonomous items would not affect consumer expenditures (or induced expenditures). If this were true, Friedman and Meiselman hypothesize that the correlation between the sum of the two autonomous components and induced expenditures should be greater than the correlation between each component individually and induced expenditures. In terms of the example used in Chapter II,

$$(4.1) \qquad r_{N(D + A)} > \begin{cases} r_{ND} \\ \text{and} \\ r_{NA} \end{cases}$$

where N is expenditures on nondurable consumer goods, D is expenditures on durable consumer goods and A is what has already been determined as autonomous. To examine this result further we need to examine the correlation coefficients.

$$(4.2) \qquad r_{N(D + A)} = \frac{\text{cov } N(D + A)}{\sqrt{\text{var } N}\ \sqrt{\text{var } D{+}A}}$$

$$= \frac{\text{cov } N\ (D + A)}{\sqrt{\text{var } N}\ \sqrt{\text{var } D + \text{var } A + 2 \text{ cov } DA}}$$

if D and A are both autonomous and independent, then cov DA = 0. If not, then it would be expected, on an <u>a priori</u> basis, that this value would be positive, i.e., cov DA $>$ 0. Also,

$$(4.3) \qquad r_{N,A} = \frac{\text{cov } N,A}{\sqrt{\text{var } N}\ \sqrt{\text{var } A}}$$

and

$$(4.4) \qquad r_{N,D} = \frac{\text{cov } N,D}{\sqrt{\text{var } N}\ \sqrt{\text{var } D}}$$

Taking one of the possible cases, any of the following conditions might hold:

$$(4.5) \qquad \frac{\text{cov N } (D + A)}{\sqrt{\text{var N}}\ \sqrt{\text{var }(D+A)}} \gtrless \frac{\text{cov N,D}}{\sqrt{\text{var N}}\ \sqrt{\text{var D}}}$$

The necessary condition for (4.1) to be satisfied is that cov N (D+A) > cov N,D. It is not sufficient, however, because var (D+A) > var D. This is true whether D and A are autonomous and independent or not. Thus, it can be seen, cov N (D+A) might be greater than cov ND but condition (4.1) would not be satisfied.

If var A is small and either cov DA is zero or small then this might not be too serious a problem. However, autonomous expenditures are presumed to be quite erratic and would therefore have a relatively large variance. If this were so then the cov N (D+A) would have to exceed cov ND by a considerable amount in order for the condition (4.1) to be satisfied. Thus, it would appear that the test proposed by Friedman and Meiselman has very little power to discriminate between autonomous and induced expenditures.

Looking at the second case, the necessary condition that must be satisfied is cov N (D+A) > cov NA. The same conclusions hold here as in the former case. Carrying this even further, it can easily be shown that cov N (D+A) =

cov ND + cov NA.[1] We would expect on an *a priori* basis that cov NA $>$ 0. An increase in autonomous expenditures would lead to an increase in income, which would bring forth an increase in expenditures on nondurable consumer expenditures. Thus,

$$(4.6)\quad \text{cov } N(D+A) = \text{cov } ND + \text{cov } NA \quad >/< \quad \text{cov } ND$$

which implies

$$(4.7)\quad \text{cov } N(D+A) > \text{cov } ND$$

since cov ND and cov NA are always positive. If D is autonomous then it would be expected that cov ND $>$ 0 and the necessary condition would be satisfied. If D is induced, the sign will also be positive. Also,

$$(4.8)\quad \text{cov } N(D+A) = \text{cov } ND + \text{cov } NA >/< \text{cov } NA$$

which implies

$$(4.9)\quad \text{cov } N(D+A) > \text{cov } NA$$

since cov ND and cov NA are always positive.

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[1]The covariance of two variables x and y is equal to E $[x-E(x)]\ [y-E(y)]$ where E is the expected value. Assume that $y = a + b$. Then

$$\begin{aligned} E[x-E(x)]\ [y-E(y)] &= E[x-E(x)]\ [a+b - E\ (a+b)] \\ &= E[x-E(x)]\ [a+b - E(a) - E(b)] \\ &= E[x-E(x)]\ [(a-E(a)) + (b-E(b))] \\ &= E\{[x-E(x)]\ [a-E(a)] + [x-E(x)]\ [b-E(b)]\} \\ &= E[x-E(x)]\ [a-E(a)] + E[x-E(x)]\ [b-E(b)] \\ &= \text{covariance } (x,a) + \text{covariance } (x,b) \end{aligned}$$

If there is an increase in autonomous expenditures then induced expenditures will increase, via the multiplier. Since, in this case, both nondurable goods and durable goods are induced, both will rise. Hence, cov ND > 0. If autonomous expenditures decline, then expenditures on both nondurable goods and durable goods will fall. As a result, cov ND will again be positive.

The necessary condition will always be satisfied. However, it still will not be possible to tell whether durable expenditures are induced or autonomous. Thus, the Friedman-Meiselman test fails to discriminate between various components of a variable. A similar analysis can be made of the determination of the money supply variable.

The narrow definition of the money supply

Since the Friedman-Meiselman test resulted in the selection of the broad definition of the money supply, no computations were made with the narrow definition of the money supply. Many economists feel that the narrow definition is the one to be preferred on both theoretical and empirical grounds.[2] However, time series data are not available for this variable going back as far as 1897. The longest series of annual data is that prepared by Friedman

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[2]Boris P. Pesek and Thomas R. Saving, Money, Wealth and Economic Theory (New York: The Macmillan Co., 1967) and Edgar L. Feige, The Demand for Liquid Assets: A Temporal Cross-Section Analysis (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964).

and Swartz for the National Bureau of Economic Research.[3] The series begins in 1915 and continues to 1946. This series is consistent with the series published by the Federal Reserve which begins in 1947 and continues to the present. Computations were made with the available data, substituting the narrow measure of the money supply for the broad definition. This would allow for a direct comparison of the two measures of the money supply. These results are presented in Tables 4-1, 4-2, and 4-3.

The results of the regressions show that if consumption is the dependent variable, the broad measure of the money supply is the more stable relation in seven periods of the eight tested. However, in five of the seven, there was a difference of less than .017 in the coefficient of correlation in any one period. If current dollar Gross National Product is used as the dependent variable then the broad measure has the higher coefficient of correlation in only four of the eight cases. Five times out of the eight periods tested, the coefficients are within .012 of each other. It would appear to be a tenuous conclusion that one measure of the money supply bears a closer relation with either consumption expenditures or current dollar Gross National Product than the other.

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[3] U. S. Department of Commerce, Long Term Economic Growth: 1860-1965 (Washington, D. C.: U. S. Government Printing Office, 1966), pp. 208-9.

TABLE 4-1. Test Using Broad Definition of Money Supply: First Set of Friedman-Meiselman Data*

Period	Constant Term	M_{2t}	R / D.W.
A. $C_t = \eta + \gamma M_{2t}$			
1920-1929	- 15290.2	1.357	.968
		(.124)	2.199
1921-1933	327.932	1.663	.897
		(.248)	.605
1929-1939	- 2496.73	1.596	.920
		(.226)	.704
1933-1938	5031.36	1.394	.991
		(.093)	2.993
1938-1953	- 1455.14	1.280	.959
		(.101)	.256
1939-1948	18165.6	.996	.964
		(.097)	.667
1929-1958	- 391.400	1.367	.976
		(.058)	.157
1948-1957	-131920.	2.201	.990
		(.112)	1.026
B. $Y_t = \eta + \gamma M_{2t}$			
1920-1929	13503.6	1.618	.933
		(.220)	2.263
1921-1933	- 20522.8	2.325	.810
		(.508)	.396
1929-1939	- 33187.3	2.372	.906
		(.370)	.703
1933-1938	- 19382.4	2.006	.988
		(.155)	2.552
1938-1953	7800.81	1.385	.964
		(.102)	.504
1929-1948	30921.7	1.089	.958
		(.116)	1.047
1929-1958	- 2410.32	1.543	.982
		(.056)	.363
1948-1957	-142404.	2.418	.987
		(.140)	1.202

*Standard errors are listed below estimated coefficients.
R is the coefficient of correlation.
D.W. is the Durbin-Watson statistic which is listed directly below the coefficient of correlation for every time period considered.

TABLE 4-2. Tests Using Broad Definition of Money Supply: Second Set of Friedman-Meiselman Data*

Period	Constant Term	M_{2t}	R / D.W.
A. $C_t = \eta + \gamma M_{2t}$			
1929-1939	- 943.465	1.527	.912
		(.229)	.629
1933-1938	7256.61	1.303	.990
		(.090)	2.939
1938-1953	- 2437.40	1.262	.958
		(.101)	.253
1939-1948	17438.1	.976	.964
		(.096)	.668
1929-1958	- 1198.28	1.351	.974
		(.059)	.152
1948-1957	-140040.	2.230	.990
		(.113)	.986
B. $Y_t = \eta + \gamma M_{2t}$			
1929-1939	- 22251.5	2.080	.915
		(.306)	.766
1933-1938	- 10104.7	1.765	.984
		(.158)	2.060
1938-1953	4818.41	1.402	.966
		(.101)	.427
1939-1948	28995.8	1.092	.967
		(.102)	1.034
1929-1958	- 3650.20	1.545	.983
		(.054)	.324
1948-1957	-139876.	2.399	.986
		(.144)	1.128

*Standard errors are listed below estimated coefficients.
R is the coefficient of correlation.
D.W. is the Durbin-Watson statistic which is listed directly below the coefficient of correlation for every time period considered.

TABLE 4-3. Using the Narrow Definition of the Money Supply*

Period	Constant Term	M_{1t}	R / D.W.
A. $C_t = \eta + \gamma M_{1t}$			
1920-1929	- 16823.1	3.532 (.440)	.943 1.767
1921-1933	- 30988.9	4.083 (3.67)	.958 1.291
1929-1939	20711.3	1.624 (.543)	.706 .350
1933-1938	11955.8	1.836 (.135)	.989 2.844
1938-1953	5332.90	1.589 (.139)	.950 .236
1939-1948	23398.6	1.225 (.135)	.955 .604
1929-1958	9822.34	1.710 (.096)	.958 .120
1948-1957	-213486.	3.555 (.267)	.978 .825
B. $Y_t = \eta + \gamma M_{1t}$			
1920-1929	- 28742.0	4.375 (.538)	.945 1.902
1921-1933	- 72293.8	6.045 (.795)	.917 .627
1929-1939	1559.0	2.403 (.835)	.692 .372
1933-1938	- 9559.82	2.645 (.203)	.988 2.842
1938-1953	13790.5	1.735 (.129)	.964 .482
1939-1948	34643.2	1.366 (.126)	.968 1.150
1929-1958	8280.29	1.942 (.091)	.971 .220
1948-1957	-234392.	3.924 (.281)	.980 1.026

*Standard errors are listed below estimated coefficients.
R is the coefficient of correlation.
D.W. is the Durbin-Watson statistic which is listed directly below the coefficient of correlation for every time period considered.

These results actually coincide with those reported by Friedman and Meiselman. A part of their Appendix, Table II-A-1 is reported in Table 4-4.[4] Three points, however, should be noted. First, except for the 1929-1939 period, their dates do not conform to those used in this thesis. Second, the data for M_1 are taken from Federal Reserve Statistics whereas the ones used in this study are those computed by Friedman and Swartz for the period 1915-1946. Third, Friedman and Meiselman also use quarterly data to support their conclusions. The reported differences are very small except for the 1929-1939 period. It has been shown, however, that there are some periods when M_1 performed considerably better than M_2. Even the regressions of $(M_2 - M_1)$ on Y_2 do not conclusively support the use of M_2 as Friedman and Meiselman claim they do.

One additional result can be obtained from these data that was not expected. In Table 4-3, the marginal velocity for the narrow definition of the money supply in both parts A and B are relatively high in the 1920-1929 period and the 1921-1933 period. This value decreased tremendously after that time period. Economists explain this fall in the marginal velocity as a shift in the demand curve for money.

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[4]Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in B. Fox and E. Shapiro, Stabilization Policies (Englewood Cliffs, N. J.: Prentice-Hall, 1963), p. 244.

TABLE 4-4. Results Shown in Friedman-Meiselman Appendix Table II-A-1. Coefficient of Determination is Shown.

		M_1	M_2
I.	Annual Data 1929-1939		
	Y_2	.512	.835
II.	Annual Data 1940-1952		
	Y_2	.882	.886
III.	Annual Data 1929-1952		
	Y_2	.955	.958
IV.	Quarterly Data 1946-1958		
	Y_2	.956	.957
V.	Quarterly Data 1946-1950		
	Y_2	.654	.779
VI.	Quarterly Data 1951-1958		
	Y_2	.899	.950

Some feel that it was this shift in individual preferences that helped account for the depression of the 1930's. Any action on the part of the monetary authorities would have to more than compensate for this, if the central bank were to stimulate economic activity.

Observing the results using M_2 in Tables 4-1 and 4-2, however, it is apparent that the large decline in the marginal velocity did not take place. There was a decline that took place over the whole decade of the thirties, but this appears to be more of a longer-term nature. Therefore, if one used M_2 as the measure of the money supply, and if the Quantity Theory represents a "valid" view of economic activity, then the decline in economic activity in the 1930's occurred primarily as a result of Federal Reserve activity and not as a result of a shift in individual preferences.

One can conclude from the results presented in this section that there is little reason to say that the broad measure of the money supply moves more closely with either consumption expenditures and/or current dollar Gross National Product than does the narrow definition of the money supply. However, the measure one chooses can drastically alter the conclusions one can infer from the data.

Periods which include the Second World War

It has been noted above that Friedman and Meiselman felt that the years of the Second World War should not be excluded from the tests. Although values of individual coefficients did change during the war period, Friedman and Meiselman contend that the results were consistent with pre- and post-war results. This is especially true of the money supply equations. However, the number of items that become insignificant during this period raises a question as to the validity of including these data.

For example, in the two periods that closely span the Second World War only the consumer price index is consistently significant at a 5% level of significance. This is shown in Table 4-5. The Friedman-Meiselman definition of autonomous expenditures is never significant in these two periods. The broad measure of the money supply is significant only when it is the single regressor or when it appears with autonomous expenditures only. Any time the consumer price index appears, it dominates the other two variables and is the only variable that possesses a coefficient significantly different from zero.

It would seem that during World War II there definitely was a change in the structure of the economy. It is correct to imply that the results obtained during this time period are consistent with the results obtained either before or after the war.

TABLE 4-5. Friedman-Meiselman Results During War Years. Second Set of Data*

	Dependent	Constant Term	A_t	M_{2t}	P_{ct}	R / D.W.
A. 1938-1953						
(i)	C_t	1257.18	-.509	1.333/		.963
			(.407)	(.114)		.315
(ii)	C_t	96779.7	1.865			.398
			(1.151)			.140
(iii)	C_t	-2437.40		1.262/		.958
				(.101)		.253
(iv)	C_t	-105819.	-.335	-.199	3714.40/	.966
			(.181)	(.213)	(502.44)	.427
(v)	C_t	-93482.3	-.376		2358.77/	.993
			(.175)		(118.252)	.893
(vi)	C_t	-111687.		-.295	3835.01/	.993
				(.225)	(542.613)	.628
(vii)	Y_t	4818.41		1.402/		.992
				(.101)		1.023
(viii)	Y_t	-94183.4		-.009	3475.27/	.988
				(.290)	(697.025)	.530
B. 1939-1948						
(i)	C_t	22696.6	-.425	1.029/		.975
			(.253)	(.090)		.969
(ii)	C_t	102058.	.494			.173
			(.994)			.156
(iii)	C_t	17438.1		.976/		.964
				(.096)		.668
(iv)	C_t	-56647.2	-.413	.136	2491.67/	.967
			(.067)	(.095)	(257.252)	1.034
(v)	C_t	-67358.1	-.399		2848.61/	.999
			(.071)		(68.871)	2.020
(vi)	C_t	-64673.7		.052	2594.57/	.998
				(.236)	(642.407)	1.939
(vii)	Y_t	28995.7		1.092/		.989
				(.102)		.863
(viii)	Y_t	-45227.0		.257	2345.31/	.984
				(.323)	(881.878)	.735

*Standard errors are listed below estimated coefficients.
R is the coefficient of correlation.
D.W. is the Durbin-Watson statistic which is listed directly below the coefficient of correlation for every time period considered.

/The regression coefficient is statistically significant at the five percent level.

Additional single equation tests--1953-1965

In order to have results of the single-equation tests that are comparable to the results obtained in the complete model, regressions were run over the same time period as the complete model using the definitions of Friedman and Meiselman and those of Hester. The regressions were run using both annual data and quarterly data. The regressions using quarterly data were divided up into five subperiods that correspond to the criteria for dating set up by Friedman and Meiselman. That is, subperiods were obtained by using turning points in the business cycle as determined by the National Bureau of Economic Research. The dates of troughs relevant for this study are the third quarter of 1954, the second quarter of 1958 and the first quarter of 1961. Peaks intermittent between these dates are the third quarter 1953, the third quarter 1957 and the second quarter 1960.

The simple least squares estimates of the equations using annual data are presented in Table 4-6. Data are in current dollars.

Once again the Friedman-Meiselman definition of autonomous expenditure performs worse in terms of its correlation with consumption expenditures than does the money supply. In this case, the results can be compared with either the narrow definition of the money supply (M_1) or the broad definition (M_2). When the consumer price index is included, the regression that includes the money supply is more closely

TABLE 4-6. The Effects of Various Exogenous Variables on Consumption Expenditures: Annual Data 1954-1965*

A. Friedman-Meiselman Variables

$$C_t = 18.020 + \underset{\substack{(1.411)\\(2.819)}}{8.009}\, A_t \qquad R = .874 \quad D.W. = .805$$

$$C_t = -570.321 + \underset{(\ .491)}{3.175}\, A_t + \underset{(\ .576)}{7.634}\, P_{ct} \qquad R = .994 \quad D.W. = 2.181$$

$$C_t = -18.562 + \underset{\substack{(0.86)\\(\ .239)}}{1.543}\, M_{2t} \qquad R = .985 \quad D.W. = .526$$

$$C_t = -327.355 + \underset{(.092)}{.967}\, M_{2t} + \underset{(.628)}{4.312}\, P_{ct} \qquad R = .998 \quad D.W. = 1.894$$

B. Narrow Definition of the Money Supply

$$C_t = -579.473 + \underset{\substack{(.356)\\(.584)}}{6.295}\, M_{1t} \qquad R = .984 \quad D.W. = .933$$

$$C_t = -678.307 + \underset{\substack{(.413)\\(.562)}}{3.942}\, M_{1t} + \underset{\substack{(.694)\\(.945)}}{4.311}\, P_{ct} \qquad R = .997 \quad D.W. = 1.378$$

C. Hester's Definitions

$$C_t = 17.469 + \underset{\substack{(.093)\\(.150)}}{2.201}\, L_{1t} \qquad R = .991 \quad D.W. = 1.056$$

$$C_t = -247.998 + \underset{(.104)}{1.517}\, L_{1t} + \underset{(.505)}{3.562}\, P_{ct} \qquad R = .999 \quad D.W. = 1.056$$

$$C_t = 25.136 + \underset{\substack{(.042)\\(.057)}}{1.451}\, L_{2t} \qquad R = .996 \quad D.W. = 1.367$$

$$C_t = -159.029 + \underset{(.080)}{1.135}\, L_{2t} + \underset{(.592)}{2.460}\, P_{ct} \qquad R = .999 \quad D.W. = 1.575$$

$$C_t = 26.949 + \underset{\substack{(.049)\\(.074)}}{1.625}\, L_{3t} \qquad R = .995 \quad D.W. = 1.200$$

$$C_t = -168.984 + \underset{(.090)}{1.251}\, L_{3t} + \underset{(.594)}{2.610}\, P_{ct} \qquad R = .999 \quad D.W. = 1.437$$

continued

TABLE 4-6--continued

C. Hester's Definitions (cont'd)

$C_t = 15.514 + \underset{\substack{(.042)\\(.066)}}{1.724}\, L_{4t}$	R = .997 D.W. = 1.120
$C_t = -108.569 + \underset{(.124)}{1.466}\, L_{4t} + \underset{(.769)}{1.682}\, P_{ct}$	R = .998 D.W. = 1.543

*Standard errors are listed below estimated coefficients.
R is the coefficient of correlation.
D.W. is the Durbin-Watson statistic which is listed directly below the coefficient of correlation for every time period considered.
Second figure in parenthesis under estimated coefficient is the standard error of the coefficient corrected for autocorrelation as described in Section F of this chapter.

C_t = Consumption expenditures.

A_t = Net private domestic investment plus the government deficit on income and product account plus the net foreign balance.

P_{ct} = Consumer price index.

M_{1t} = Currency in public circulation plus adjusted demand deposits.

M_{2t} = M_{1t} + time deposits in commercial banks.

L_{1t} = Net private domestic investment plus total government expenditures plus net foreign balance.

L_{2t} = Gross private domestic investment plus total government expenditures plus exports.

L_{3t} = L_{2t} minus imports.

L_{4t} = L_{2t} minus inventory investment.

correlated with consumption than the regression that utilizes autonomous expenditures, although the differences are only marginal.

The results are somewhat different when the money supply equations are compared with the equations that contain Hester's definitions of autonomous expenditures. In every case, Hester's definitions are more closely correlated with consumption than is either the narrow or broad definition of the money supply. This remains true when the consumer price index is added. It should be noted, however, that the differences are not large.

In the fourteen equations tested, six show positive signs of autocorrelation at a 5% level of significance according to the Von Neuman-Hart statistic: All the parameters have coefficients that are at least four times their standard error. When the standard errors are corrected in the manner described below, all parameters remain significantly different from zero.

On the basis of looking at the single-equation tests on annual data one could conclude that the definition of "autonomous" was again quite important. If an economist took the Friedman-Meiselman definitions, he would conclude that the money supply formulation was the relatively more stable relationship. If Hester's definitions were used, the conclusions reached would differ, since both relationships were of about the same stability.

In Table 4-7, least squares estimates using quarterly data are presented. Once again the variables are measured in current dollars. In all periods examined, the Friedman-Meiselman definition of autonomous is out-performed by either measure of the money supply in terms of how closely these variables are correlated with consumption expenditures. It is interesting to note that in all subperiods, using the criterion of the highest coefficient of correlation, the broad measure of the money supply performs better than the narrowly defined money supply.

The comparison of Hester's measures of autonomous expenditures with the broad measure of the money supply reveals little difference in the stability of the two different relationships. The results, must be interpreted with care, for the dependent variable is, in all cases, the same. This is the only way the coefficients of correlation can be compared. However, Friedman and Meiselman felt that autonomous expenditures should explain all induced expenditures. Therefore, if the autonomous component varies then the induced component should vary, too.

Excluding the test over the whole period, M_2 performed considerably better than Hester's L_1 in three cases and in two cases there was little difference. M_2 performed better than L_2 in only one case, with little difference in the other four cases. M_2 did better than L_3 in two cases, with marginal difference in two other cases. M_2 performed better

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TABLE 4-7. The Effects of Various Exogenous Variables on Consumption Expenditures: Quarterly Data 1953 III to 1965 IV.*

A. Friedman-Meiselman Variables

A.1. $C_t = \alpha + \beta A_t$

	Period	Constant Term	A_t	R / D.W.
(i)	1953 III - 1965 IV	35.353	7.514	.845
			(.687)	.369
			(2.008)	
(ii)	1954 III - 1958 II	225.015	1.238	.150
			(2.178)	.055
(iii)	1953 III - 1957 III	- 32.033	8.577	.805
			(1.629)	.807
(iv)	1958 II - 1961 I	396.439	- 2.455	.526
			(1.257)	.478
(v)	1957 III - 1960 II	294.952	.200	.043
			(1.477)	.092
(vi)	1960 II - 1965 IV	178.232	4.622	.926
			(.410)	.815
			(.798)	

A.2. $C_t = \alpha + \beta A_t + \delta P_{ct}$

	Period	Constant Term	A_t	P_{ct}	R / D.W.
(i)	1953 III - 1965 IV	-588.95	2.635	8.022	.989
			(.283)	(.340)	.687
			(.606)		
(ii)	1954 III - 1958 II	-334.275	1.825	5.662	.968
			(.576)	(.412)	.731
			(1.232)		
(iii)	1953 III - 1957 III	-435.279	2.906	6.312	.922
			(1.704)	(1.453)	.365
(iv)	1958 II - 1961 I	-822.117	.523	10.976	.961
			(.545)	(1.246)	.739
(v)	1957 III - 1960 II	-735.660	.281	10.221	.948
			(.494)	(1.140)	.787
(vi)	1960 II - 1965 IV	-1,455.64	.392	17.120	.994
			(.307)	(1.144)	1.114

continued

TABLE 4-7--continued

A.3. $C_t = \alpha + \gamma M_{2t}$

	Period	Constant Term	M_{2t}	R / D.W.
(i)	1953 III - 1965 IV	- 19.400	1.542	.983
			(.042)	.072
			(.267)	
(ii)	1954 III - 1958 II	-238.815	2.691	.962
			(.206)	.515
			(.357)	
(iii)	1953 III - 1957 III	-248.136	2.749	.983
			(.133)	.302
(iv)	1958 II - 1961 I	-289.801	2.887	.846
			(.574)	.541
			(1.345)	
(v)	1957 III - 1960 II	- 97.425	1.959	.858
			(.370)	.293
			(.811)	
(vi)	1960 II - 1965 IV	72.4305	1.192	.998
			(.017)	.946
			(.030)	

A.4. $C_t = \alpha + \gamma M_{2t} + \delta P_{ct}$

	Period	Constant Term	M_{2t}	P_{ct}	R / D.W.
(i)	1953 III - 1965 IV	-338.330	.939	4.477	.997
			(.042)	(.289)	.372
			(.129)		
(ii)	1954 III - 1958 II	-251.146	2.100	1.294	.963
			(.786)	(1.659)	.431
			(1.536)		
(iii)	1953 III - 1957 III	-350.591	2.162	2.236	.991
			(.187)	(.606)	.489
(iv)	1958 II - 1961 I	-695.182	.627	8.618	.963
			(.536)	(1.680)	.575
(v)	1957 III - 1960 II	-664.169	.285	9.028	.948
			(.501)	(2.367)	.719
(vi)	1960 II - 1965 IV	759.248	1.683	- 7.659	.998
			(.220)	(3.417)	1.174
			(.332)		

continued

TABLE 4-7--continued

B. Narrow Definition of the Money Supply

B.1. $C_t = \alpha + \gamma M_{1t}$

	Period	Constant Term	M_{1t}	$\bar{R}$ D.W.
(i)	1953 III - 1965 IV	-574.69	6.262 (.167) (.534)	.983 .169
(ii)	1954 III - 1958 II	-781.759	7.745 (.089) (.272)	.918 .407
(iii)	1953 III - 1957 III	-480.958	5.508 (.384)	.965 .227
(iv)	1958 II - 1961 I	-273.745	4.154 (2.398)	.480 .139
(v)	1957 III - 1960 II	-339.359	4.581 (1.074) (1.994)	.803 .332
(vi)	1960 II - 1965 IV	-350.656	4.812 (.087) (.142)	.997 1.040

B.2. $C_t = \alpha + \gamma M_{1t} + \delta P_{ct}$

	Period	Constant Term	M_{1t}	P_{ct}	$\bar{R}$ D.W.
(i)	1953 III - 1965 IV	-673.468	3.851 (.195) (.597)	4.395 (.327)	.997 .368
(ii)	1954 III - 1958 II	-606.114	4.038 (.433) (.527)	3.420 (.303)	.993 1.298
(iii)	1953 III - 1957 III	-584.749	3.768 (.169)	3.581 (.268)	.997 1.142
(iv)	1958 II - 1961 I	-928.517	1.910 (.587) (.884)	9.548 (.725)	.980 .962
(v)	1957 III - 1960 II	-721.206	1.208 (.838)	8.492 (1.586)	.956 .697
(vi)	1960 II - 1965 IV	-350.656	3.278 (.596) (.864)	5.954 (2.294)	.997 1.230

continued

TABLE 4-7--continued

C. Hester's Definitions

C.1. $C_t = \lambda + \eta L_{1t}$

	Period	Constant Term	L_{1t}	$\frac{R}{D.W.}$
(i)	1953 III - 1965 IV	15.745	2.208	.984
			(.058)	.486
			(.150)	
(ii)	1954 III - 1958 II	84.695	1.581	.731
			(.395)	.164
			(1.021)	
(iii)	1953 III - 1957 III	44.823	1.872	.950
			(.160)	.496
(iv)	1958 II - 1961 I	110.969	1.552	.774
			(.402)	.785
			(.693)	
(v)	1957 III - 1960 II	120.171	1.440	.840
			(.294)	1.058
			(.406)	
(vi)	1960 II - 1965 IV	71.777	1.875	.988
			(.065)	.778
			(.129)	

C.2. $C_t = \lambda + \eta L_{1t} + \delta P_{ct}$

	Period	Constant Term	L_{1t}	P_{ct}	$\frac{R}{D.W.}$
(i)	1953 III - 1965 IV	-302.22	1.375	4.289	.996
			(.075)	(.356)	.752
			(.145)		
(ii)	1954 III - 1958 II	-252.078	.741	4.545	.988
			(.108)	(.295)	.690
			(.239)		
(iii)	1953 III - 1957 III	-180.182	1.295	3.085	.965
			(.269)	(1.257)	.335
(iv)	1958 II - 1961 I	-606.773	.615	8.251	.988
			(.130)	(.690)	1.786
(v)	1957 III - 1960 II	-533.864	.623	7.529	.983
			(.144)	(.907)	1.511
(vi)	1960 II - 1965 IV	-1,060.39	.607	12.621	.995
			(.224)	(2.191)	1.021
			(.364)		

continued

TABLE 4-7--continued

C.3. $C_t = \lambda + \eta L_{2t}$

	Period	Constant Term	L_{2t}	$\frac{R}{D.W.}$
(i)	1953 III - 1965 IV	24.054	1.454	.993
			(.025)	.594
			(.060)	
(ii)	1954 III - 1958 II	59.219	1.232	.895
			(.164)	.223
			(.392)	
(iii)	1953 III - 1957 III	56.813	1.222	.977
			(.069)	.453
(iv)	1958 II - 1961 I	67.731	1.261	.852
			(.245)	.856
			(.398)	
(v)	1957 III - 1960 II	80.909	1.171	.915
			(.163)	1.323
			(.174)	
(vi)	1960 II - 1965 IV	64.162	1.294	.991
			(.039)	.705
			(.083)	

C.4. $C_t = \lambda + \eta L_{2t} + \delta P_{ct}$

	Period	Constant Term	L_{2t}	P_{ct}	$\frac{R}{D.W.}$
(i)	1953 III - 1965 IV	-199.191	1.066	2.996	.997
			(.049)	(.357)	.778
			(.097)		
(ii)	1954 III - 1958 II	-185.645	.618	3.652	.993
			(.068)	(.290)	.802
			(.131)		
(iii)	1953 III - 1957 III	- 67.345	1.017	1.676	.980
			(.142)	(1.028)	.362
(iv)	1958 II - 1961 I	-559.590	.534	7.552	.992
			(.087)	(.626)	2.253
(v)	1957 III - 1960 II	-451.011	.577	6.404	.987
			(.109)	(.920)	1.799
(vi)	1960 II - 1965 IV	-928.259	.524	11.112	.996
			(.157)	(2.229)	1.042
			(.252)		

continued

TABLE 4-7--continued

C.5. $C_t = \lambda + \eta L_{3t}$

	Period	Constant Term	L_{3t}	R / D.W.
(i)	1953 III - 1965 IV	26.035	1.629	.991
			(.032)	.613
			(.076)	
(ii)	1954 III - 1958 II	55.901	1.413	.878
			(.206)	.228
			(.487)	
(iii)	1953 III - 1957 III	52.575	1.406	.977
			(.080)	.491
(iv)	1958 II - 1961 I	83.131	1.341	.807
			(.310)	.918
			(.516)	
(v)	1957 III - 1960 II	85.779	1.298	.897
			(.202)	1.295
			(.237)	
(vi)	1960 II - 1965 IV	69.002	1.434	.986
			(.052)	.699
			(.109)	

C.6. $C_t = \lambda + \eta L_{3t} + \delta P_{ct}$

	Period	Constant Term	L_{3t}	P_{ct}	R / D.W.
(i)	1953 III - 1965 IV	-220.718	1.151	3.302	.997
			(.057)	(.372)	.802
			(.110)		
(ii)	1954 III - 1958 II	-198.608	.692	3.796	.992
			(.080)	(.293)	.745
			(.158)		
(iii)	1953 III - 1957 III	- 75.043	1.163	1.731	.981
			(.160)	(1.006)	.385
(iv)	1958 II - 1961 I	-593.194	.541	7.993	.989
			(.105)	(.679)	2.036
(v)	1957 III - 1960 II	-478.721	.610	6.752	.985
			(.127)	(.945)	1.708
(vi)	1960 II - 1965 IV	-1,103.15	.428	13.088	.995
			(.169)	(2.165)	.942
			(.288)		

continued

TABLE 4-7--continued

C.7. $C_t = \lambda + \eta L_{4t}$

	Period	Constant Term	L_{4t}	$\frac{R}{D.W.}$
(i)	1953 III - 1965 IV	11.365	1.745 (.027) (.097)	.994 .350
(ii)	1954 III - 1958 II	48.395	1.486 (.087) (.172)	.977 .514
(iii)	1953 III - 1957 III	28.351	1.601 (.146)	.943 .332
(iv)	1958 II - 1961 I	-44.914	2.120 (.189)	.962 1.792
(v)	1957 III - 1960 II	-85.054	2.357 (.188) (.298)	.970 1.085
(vi)	1960 II - 1965 IV	43.198	1.594 (.045) (.098)	.992 .635

C.8. $C_t = \lambda + \eta L_{4t} + \delta P_{ct}$

	Period	Constant Term	L_{4t}	P_{ct}	$\frac{R}{D.W.}$
(i)	1953 III - 1965 IV	-158.334	1.381 (.070) (.207)	2.320 (.428)	.997 .408
(ii)	1954 III - 1958 II	- 67.058	1.044 (.167) (.383)	1.891 (.647)	.986 .619
(iii)	1953 III - 1957 III	- 17.162	1.482 (.493)	.663 (2.632)	.943 .298
(iv)	1958 II - 1961 I	-396.159	1.170 (.362) (.449)	5.026 (1.756)	.980 1.099
(v)	1957 III - 1960 II	-404.507	1.456 (.171) (.220)	4.648 (.760)	.994 1.493
(vi)	1960 II - 1965 IV	-931.528	.646 (.271) (.503)	11.063 (3.139)	.995 .844

*Standard errors are listed below estimated coefficients.
R is the coefficient of correlation.
D.W. is the Durbin-Watson statistic which is listed directly

continued

TABLE 4-7--continued

below the coefficient of correlation for every time period considered.

Second figure in parenthesis under estimated coefficient is the standard error of the coefficient corrected for autocorrelation as described in Section F of this chapter.

C_t = Consumption expenditures.

A_t = Net private domestic investment plus the government deficit on income and product account plus the net foreign balance.

P_{ct} = Consumer price index.

M_{1t} = Currency in public circulation plus adjusted demand deposits.

M_{2t} = M_{1t} + time deposits in commercial banks.

L_{1t} = Net private domestic investment plus total government expenditures plus net foreign balance.

L_{2t} = Gross private domestic investment plus total government expenditures plus exports.

L_{3t} = L_{2t} minus imports.

L_{4t} = L_{2t} minus inventory investment.

than L_4 in only one case with just one case showing little difference.

The narrow definition of the money supply, however, did not do so well. In fact, Hester's measures consistently outperform M_1.

When real values are considered, both measures of the money supply do worse than the measures posed by Hester. There is only a marginal difference between the money supply measures and the Friedman-Meiselman definition of autonomous expenditure.

There is also a noticeable difference in the behavior of the marginal velocity of circulation of the two money supply measures. If the broad measure of the money supply is used, the marginal velocity is of similar magnitude in three of the periods under review, but declines seriously in the periods from 1957-III to 1960-II and from 1960-II to 1965-IV. Both of these periods represent measures from peak-to-peak, reflecting a growth in consumption expenditures which exceeds the growth of the money supply measure. In other words, there was a decline in the demand for money, broadly defined, during these time periods. The latter decline was of considerable magnitude.

An examination of the marginal velocity of circulation of the narrow measure of the money supply shows that in the earliest two periods under review this value decreased quite rapidly. However, a review of the latter three periods show that the marginal velocity remained relatively constant. If M_1 is used as a measure of the money supply, it would be inferred that there was an increase in the demand for money in the trough-to-trough period from 1954-III to 1958-II but a decline in the demand for money occurred in the peak-to-peak time period covering from 1957-III to 1960-II. After this latter shift took place, the demand for money remained relatively stable up to the end of the period discussed in this thesis.

Stability of the demand for money in real terms seems to be nonexistent. The problem of comparison is difficult in this instance because several of the coefficients of M_1 and M_2 are not significantly different from zero. Of those values of M_2 that are significantly different from zero, there does appear to be greater stability than exists between the nominal measures of the variables. The marginal velocity of real money balances, in forms of M_1 or M_2 shows a general decline. This would indicate that there was a secular decline in the demand for real money balances.

The values of the marginal multiplier show varied results. The Friedman-Meiselman multiplier shows little stability. One problem here is that in the five periods reviewed, this value is insignificant in two and possesses a wrong sign in the third. In terms of real values, their measure is insignificant in four out of the five cases tested. When the standard error is corrected for the presence of autocorrelation, all five are insignificant.

The measures devised by Hester show an entirely different pattern. The stability of the marginal multiplier is quite remarkable for all variables except L_4. This is shown in Table 4-8. It should be noted, however, that L_4 performed better than the others in terms of its correlation with consumption expenditures. This stability is still quite evident in real terms, as can be seen from Table 4-7.

The final comparison of the different measures is conducted in terms of the partial correlation coefficients. This is the same test performed by Friedman and Meiselman in which they attempted to determine the relative importance of two measures in a multiple regression equation. This examination will be carried one step further by including Beta coefficients. This latter value measures the relative importance of the individual regressors by weighting the regression coefficients with the ratio of the standard error of the variable in question to the standard error of the dependent variable.[5] Partial correlation coefficients are shown in Table 4-9 while Beta coefficients are shown in Table 4-10.

If the Friedman-Meiselman measure of autonomous expenditures is used the results are very one-sided. In all periods

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[5]Mordechai Ezekiel and Karl A. Fox, <u>Methods of Correlation and Regression Analysis</u> (New York: John Wiley and Sons, Inc., 1959), pp. 147-48. Arthur S. Goldberger, <u>Econometric Theory</u> (New York: John Wiley and Sons, Inc., 1964), pp. 197-98.

TABLE 4-8. Marginal Multipliers Associated with Hester's Definitions of Autonomous Expenditures.

Period	Marginal Multiplier of: L_1	L_2	L_3	L_4
1954 III - 1958 II	1.58	1.23	1.41	1.49
1953 III - 1957 III	1.87	1.22	1.41	1.60
1958 II - 1961 I	1.55	1.26	1.34	2.12
1957 III - 1960 II	1.44	1.17	1.30	2.36
1960 II - 1965 IV	1.88	1.29	1.43	1.59

TABLE 4-9. Partial Correlations Between Variables in Nominal Terms

A.

	Period	r_{CA}	$r_{CA.M_1}$	$r_{CA.M_2}$	r_{CM_1}	$r_{CM_1.A}$	r_{CM_2}	$r_{CM_2.A}$
(i)	1954 III - 1958 II	.150	-.657	.560	.918	.953	.962	.973
(ii)	1953 III - 1957 III	.805	.454	.635	.965	.920	.983	.971
(iii)	1958 II - 1961 I	.526	-.704	-.582	.480	.681	.846	.861
(iv)	1957 III - 1960 II	.043	-.573	-.529	.803	.873	.858	.900
(v)	1960 II - 1965 IV	.926	.039	.054	.997	.976	.998	.985

B.

	Period	r_{CL_1}	$r_{CL_1.M_1}$	$r_{CL_1.M_2}$	r_{CM_1}	$r_{CM_1.L_1}$	r_{CM_2}	$r_{CM_2.L_1}$
(i)	1954 III - 1958 II	.731	-.325	.866	.918	.836	.962	.980
(ii)	1953 III - 1957 III	.950	.694	.895	.965	.801	.983	.965
(iii)	1958 II - 1961 I	.774	.693	.511	.480	-.053	.846	.692
(iv)	1957 III - 1960 II	.840	.572	.588	.803	.433	.858	.643
(v)	1960 II - 1965 IV	.988	.519	.046	.997	.894	.998	.913

C.

	Period	r_{CL_2}	$r_{CL_2.M_1}$	$r_{CL_2.M_2}$	r_{CM_1}	$r_{CM_1.L_2}$	r_{CM_2}	$r_{CM_2.L_2}$
(i)	1954 III - 1958 II	.895	.189	.912	.918	.487	.962	.968
(ii)	1953 III - 1957 III	.977	.817	.938	.965	.714	.983	.955
(iii)	1958 II - 1961 I	.852	.812	.651	.480	-.213	.846	.636
(iv)	1957 III - 1960 II	.915	.754	.742	.803	.242	.858	.521
(v)	1960 II - 1965 IV	.991	.583	.138	.997	.869	.998	.884

D.

	Period	r_{CL_3}	$r_{CL_3 \cdot M_1}$	$r_{CL_3 \cdot M_2}$	r_{CM_1}	$r_{CM_1 \cdot L_3}$	r_{CM_2}	$r_{CM_2 \cdot L_3}$
(i)	1954 III - 1958 II	.878	.101	.908	.918	.568	.962	.971
(ii)	1953 III - 1957 III	.977	.808	.927	.965	.696	.983	.946
(iii)	1958 II - 1961 I	.807	.742	.583	.480	-.086	.846	.681
(iv)	1957 III - 1960 II	.897	.714	.708	.803	.328	.858	.570
(v)	1960 II - 1965 IV	.986	.516	-.033	.997	.904	.998	.922

E.

	Period	r_{CL_4}	$r_{CL_4 \cdot M_1}$	$r_{CL_4 \cdot M_2}$	r_{CM_1}	$r_{CM_1 \cdot L_4}$	r_{CM_2}	$r_{CM_2 \cdot L_4}$
(i)	1954 III - 1958 II	.977	.860	.938	.918	.339	.962	.895
(ii)	1953 III - 1957 III	.943	.916	.936	.965	.949	.983	.980
(iii)	1958 II - 1961 I	.962	.951	.860	.480	-.009	.846	.019
(iv)	1957 III - 1960 II	.970	.915	.907	.803	.193	.858	.465
(v)	1960 II - 1965 IV	.992	.663	-.017	.997	.873	.998	.864

TABLE 4-10. Beta Coefficients of Various Measures of Autonomous Expenditures and Money Supply in Nominal Terms

A.		$C_t = \alpha + \beta A_t + \gamma M_{1t}$		$C_t = \alpha + \beta A_t + \gamma M_{2t}$	
	Period	A	M	A	M_2
(i)	1953 III - 1965 IV				
(ii)	1954 III - 1958 II	-.287	1.039	.154	.962
(iii)	1953 III - 1957 III	.180	.830	.173	.855
(iv)	1958 II - 1961 I	-.627	.588	-.322	.760
(v)	1957 III - 1960 II	-.379	.968	-.289	.959
(vi)	1960 II - 1965 IV	.009	.989	.009	.989
B.		$C_t = \alpha + \beta L_{1t} + \gamma M_{1t}$		$C_t = \alpha + \beta L_{1t} + \gamma M_{2t}$	
	Period	L_1	M_1	L_1	M_2
(i)	1953 III - 1965 IV				
(ii)	1954 III - 1958 II	-.257	1.141	.286	.803
(iii)	1953 III - 1957 III	.421	.585	.360	.662
(iv)	1958 II - 1961 I	.803	- .044	.370	.596
(v)	1957 III - 1960 II	.546	.376	.452	.522
(vi)	1960 II - 1965 IV	.234	.767	.020	.978
C.		$C_t = \alpha + \beta L_{2t} + \gamma M_{1t}$		$C_t = \alpha + \beta L_{2t} + \gamma M_{2t}$	
	Period	L_2	M_1	L_2	M_2
(i)	1953 III - 1965 IV				
(ii)	1954 III - 1958 II	.238	.692	.388	.666
(iii)	1953 III - 1957 III	.585	.421	.464	.552

(iv)	1958 II - 1961 I	.951	- .149	.502	.483
(v)	1957 III - 1960 II	.777	.169	.635	.350
(vi)	1960 II - 1965 IV	.290	.710	.069	.930

D.

	Period	$C_t = \alpha + \beta L_{3t} + \gamma M_{1t}$ L_3	M_1	$C_t = \alpha + \beta L_{3t} + \gamma M_{2t}$ L_3	M_2
(i)	1953 III - 1965 IV				
(ii)	1954 III - 1958 II	.118	.807	.370	.689
(iii)	1953 III - 1957 III	.588	.416	.464	.551
(iv)	1958 II - 1961 I	.850	-.066	.427	.553
(v)	1957 III - 1960 II	.705	.240	.582	.403
(vi)	1960 II - 1965 IV	.222	.778	-.014	1.012

E.

	Period	$C_t = \alpha + \beta L_{4t} + \gamma M_{1t}$ L_4	M_1	$C_t = \alpha + \beta L_{4t} + \gamma M_{2t}$ L_4	M_2
(i)	1953 III - 1965 IV				
(ii)	1954 III - 1958 II	.818	.175	.585	.436
(iii)	1953 III - 1957 III	.446	.589	.355	.672
(iv)	1958 II - 1961 I	.964	-.003	.953	.011
(v)	1957 III - 1960 II	.907	.079	.808	.197
(vi)	1960 II - 1965 IV	.331	.670	-.010	1.008

tested, the partial correlation coefficient of either measure of the money supply holding autonomous expenditures constant, is relatively close to the simple correlation coefficient obtained in the earlier tests. The partial correlation coefficient of autonomous expenditures, holding either measure of the money supply constant, is considerably lower than the simple correlation coefficient. Also, the sign of autonomous expenditures is negative in many cases. The Beta coefficients reflect the same general impression. In all cases the Beta coefficients of either measure of the money supply are larger. It could be inferred from these tests, that if this measure of autonomous expenditures is correct, then either measure of the money supply is relatively more important and most of the observed influence of autonomous expenditures on consumption expenditures represent the hidden influence of the money supply.

When Hester's measures of autonomous expenditures are used the results are mixed. Also, there is a considerable difference in the results depending upon which definition of the money supply is used. The measure L_1, does not compare well with the narrow definition of the money supply. Its partial correlation coefficient, holding M_1 constant, is much lower than its simple correlation coefficient in the majority of cases. The Beta coefficients, however, are larger for M_1 than for L_1 in every case. This is also true if the broad measure of the money supply is used rather than the narrow one.

The use of one of the other three measures instead of L_1 reverses the situation relative to M_1. The partial correlation coefficients of L_2, L_3 or L_4 holding M_1 constant are closer to their simple correlation coefficients than those of M_1 holding L_2, L_3 or L_4 constant, in three of the five cases tested. The Beta coefficients of L_2, L_3 or L_4 are also larger than those of M_1 in three of the five cases tested. It is interesting to note that the cases that favor different measures of autonomous expenditures are not the same in all instances.

These results, although they would not reverse the conclusions obtained with the first two measures of autonomous expenditures, would at least show that in the case of M_1, the money supply is not relatively more important than some measures of autonomous expenditures. The problem again reduces to that of choosing the most appropriate definition of the variables in question.

If M_2 is the appropriate measure of the money supply, L_4 is the only measure of autonomous expenditure that performs better than this money supply measure. M_2 performs marginally better than L_2 and quite a bit better than L_3. The results, however, are not so one-sided as to allow for a definite conclusion to be reached. M_2 apparently performs better than M_1 relative to these latter three measures of autonomous expenditure, but again the difference is not overwhelming.

Unless one makes a definite selection of either A or L, as the correct measure of autonomous expenditure, it is impossible, at this stage, to draw any conclusion as to the most important variable or the one that possesses the greatest relative stability. Additional problems associated with single-equation tests also indicate that perhaps it is not possible to reach any firm conclusion within the framework of these simple models. This will be discussed next.

Autocorrelation

The problem of autocorrelation was mentioned earlier in this chapter. This problem is common in time series analysis and two reasons are given for its possible cause. First, trend may be a very important element in the observations on the dependent variable under examination. If this is true, then the residuals of successive time periods cannot be considered to be random. Second, both the regressor and the regressand may be influenced by a third variable which also moves in the same direction. This third variable may be autocorrelated with both of the former.

If the technique of simple least squares is used in estimating a relationship between two variables the presence of autocorrelation has two main consequences on the estimates. Although the estimates themselves are unbiased, they are inefficient. However, the use of the least-square method will bias the standard errors downward so as to cover up the inefficiency of the estimates.

Several methods exist of correcting for the presence of autocorrelation. The one that will be used in this thesis is that developed by Wold[6] to correct the standard error for its downward bias. Wold makes the basic assumption that the observed residual, ζ, is a function of all past and present values of the true error term, ε. The relationship is assumed to be linear.

$$(4.1) \qquad \zeta_t = \varepsilon_t + a_1\varepsilon_{t-1} + a_2\varepsilon_{t-2} + \ldots$$

$$\text{where} \quad \sum_{i=1}^{\infty} a_i^2 < \infty$$

$$\text{and} \quad E(\varepsilon_t) = 0$$

$$E(\varepsilon_t \; \varepsilon_{t+v}) = 0 \quad (v = \pm 1, \pm 2, \ldots)$$

If ρ_1 is the autocorrelation coefficient between successive residuals and ρ_2 is that between residuals lagged two periods, then the standard errors can be multiplied by $\sqrt{1 + 2\rho_1 + 2\rho_2 + \ldots}$ to correct for the autocorrelation present. It can be assumed that $\rho_2 = \rho_1^2$, $\rho_3 = \rho_1^3$, and so on. The correlation exhibited between terms beyond ρ_1 will, therefore, be very slight. A good approximation can be obtained with knowledge of just ρ_1.

This correction has been made on both the Friedman-Meiselman data and the data presented in previous subsections

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[6]Herman Wold, Demand Analysis (New York: John Wiley and Sons, Inc., 1951), pp. 210-11. Also see Ezekiel and Fox, op. cit., pp. 335.

of this chapter. Some results of this correction appear in Tables 4-6 and 4-7. Results concerning the Friedman-Meiselman data are presented in Appendix A.

Simultaneous equation bias

This problem has been advanced in most of the discussions of the Friedman-Meiselman paper. Essentially, the difficulty is that in single-equation models, such as the ones that have been tested so far, the independent variable is not exogenous to the economic system in a statistical sense because it is not independent of the error term in the equation. This means that simple least square estimates of the coefficient of the regressor will be biased. Also, the coefficient of correlation will be biased; in some cases upward, and in some cases downward. The lack of independence of certain variables can be explained by demonstration.

As an example, assume that the two specified "independent" variables are the Federal Government's deficit and the money supply. Generally, it is felt that the tax collections of the Federal Government are endogenous to the system. That is, they are affected by other economic magnitudes. In the case of tax collections, the level of income is assumed to influence the amount of taxes collected. The larger the level of income received in a society, the greater are the taxes its citizens have to pay. The money supply is also considered by many to be endogenous. In the development of the more complex model of Chapter III, the level of interest rates was included as a determinant of the money supply. It could be argued that a rise in incomes would lead to an increase in the demand for loanable funds. This, holding all other things constant, would cause commercial bankers to squeeze their reserves further and increase the amounts of their loans outstanding. Thus, by allowing demand deposits to increase, the money supply would increase.

Suppose the equation being tested includes the government deficit and current dollar Gross National Product. If it is assumed that the money supply is increased during the time period under review and it is also assumed that the money supply can influence the level of income in society this increase would raise the level of income of the society and, consequently, would increase the taxes paid by the individuals of a society. This would mean the government deficit would be smaller than it otherwise would be. It might even result in a surplus (which would result in a negative correlation with Gross National Product). Thus, a given level of Gross National Product would be associated with a smaller deficit than in the case of no increase in the money supply or it might even be associated with a surplus. Either result would affect the coefficient of the government deficit and might even reverse its sign. This, of course, would tend to reduce the coefficient of correlation.

Assume now that Gross National Product is regressed upon the money supply. Also, assume that the deficit is positively related to this latter figure. If the deficit increases, this would raise current dollar Gross National Product. As discussed above, this movement will tend to raise interest rates, which will result in an increase in the money supply. Similar to the previous case, the coef-fient of the money supply would be affected. Also, the coefficient of correlation would be altered, but since the two variables move in the same direction, its value would generally not be reduced.

If the independent variables are not truly exogenous to the equation, then the equation is misspecified and the regressor is not independent of the disturbance term. In the example given, the result would be that the correlation between the government deficit and current dollar Gross National Product would be weaker relative to the correlation between the money supply and current dollar Gross National Product.

This helps to explain some of the results obtained in Tables 4-9 and 4-10. The coefficient of autonomous expendi-tures as defined by Friedman and Meiselman is negative in only one case in Table 4-7, Part A, and it is negative in three cases in Table 4-9, Part A, when multiple regression techniques are used and M_1 is the second regressor. One would expect this coefficient to always be positive. Apparently, the effect of other variables has been so great as to reverse the sign from positive to negative. How greatly the value of the other coefficients have been affected or the extent to which the coefficient of correlation has been affected is unknown. From these results, however, it is very likely that they have been affected in the direction indicated above.

The major justification for the use of the classical least-squares technique is that the estimates possess the minimum variance property. Thus, even though the estimates are biased, they have a smaller variance than those obtained by other estimation methods, as for example, the two-stage least-squares method. This becomes quite important in small samples, because if the variance is sufficiently small, it can compensate for the bias of the estimate.[7] Classical least squares would give results that would not vary significantly from the results obtained by other methods. In large samples, however, the variances of both classical least squares and two-stage least squares go to zero. However, the bias of classical least squares remains.

Summary

There exists several problems that single-equation estimation techniques cannot handle. Theoretically, the problem of simultaneous equation bias requires the use of a complete model.

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[7]Arthur S. Goldberger, op. cit., p. 360.

Empirically, the results of many of the tests performed in this chapter indicate that the conclusion one draws depends, to a great extent, upon the definition of the variables used. As in the case of Hester's measures of autonomous expenditure, the results concerning the relative stability of either model allow for no definite conclusion, whereas the use of the Friedman-Meiselman measure results in the formidable support of the Quantity Theory model.

Also, the transmission process is hidden in a single-equation model, and attempts to identify it can be achieved only through the use of the larger model. A more complete model can reduce this problem to some extent. That is, a greater degree of disaggregation can be achieved with a more complete model.

Thus, the only possible path open to a researcher interested in the relative effects of selected exogenous components of aggregate demand upon important endogenous variables is that of more complete and complex econometric models. This eliminates the simple concepts of "the multiplier" and "the income velocity of circulation." The indicated trade off between simplicity and increased information, in this case, seems to favor the use of the more complex models. Therefore, this is the direction taken in Chapter V.

CHAPTER V

THE COMPLETE MODEL

This chapter presents the results of estimation of the complete model and various experiments designed to assess the relative importance of monetary and fiscal policy. Initially, however, there is a discussion of some statistical problems associated with the estimation of the complete econometric model.

Identification

One problem faced prior to the estimation of an economic model is that of identification. Basically, the problem of parameter identification reduces the question of whether or not the parameters of an equation that is part of a system of equations can be uniquely determined from the estimated parameters of a system of reduced form equations. If it is possible to estimate all of the parameters in each of the structural equations from a complete system, then it is said that the system is identified. If all of the parameters in the set of equations cannot be uniquely estimated, the system is said to be not identified.

The condition of identification is usually derived in terms of the rank of the matrix of reduced form parameters. Since the rank of this matrix cannot exceed the number of rows, it is common practice to use the order condition of identifiability which is derived from the rank condition of identifiability. The order condition is a necessary, though not sufficient, condition for identifiability. And, it is much easier to apply than the rank condition. The order condition for identifiability states that if an equation is to be identified, the number of predetermined variables excluded from the equation must be at least as great as one less than the number of dependent variables included in the equation.[1]

The complete model to be tested is a system of nine equations with nine endogenous variables. For convenience the complete model is reproduced again.

(5.1) $Y_t = C_t + I_t + G_t + E_t - O_t$

(5.2) $C_t = \alpha_0 + \alpha_1 Y_t^d + \alpha_2 C_{t-1} + \alpha_3 M_t + \alpha_4 M_{t-1}$

(5.3) $I_t = \beta_0 + \beta_1 (C_{t-1} - C_{t-2}) + \beta_2 Y_t + \beta_3 r_{t-2}^l + \beta_4 I_{t-1}$

(5.4) $Y_t^d = \gamma_1 Y_t$

(5.5) $O_t = \eta_0 + \eta_1 Y_t$

(5.6) $r_t^l = \varepsilon_0 + \varepsilon_1 r_t^s + \varepsilon_2 Y_t$

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[1]Arthur S. Goldberger, Econometric Theory (New York: John Wiley & Sons, Inc., 1964), p. 316. Also, J. Johnston, Econometric Methods (New York: McGraw Hill, 1963), pp. 250-252.

(5.7) $r_t^s = \lambda_0 + \lambda_1 Y_t + \lambda_2 M_t^d$

(5.8) $M_t^s = \delta_0 + \delta_1 r_t^s + \delta_2 r_t^d + \delta_3 B_t$

(5.9) $M_t^s = M_t^d = M_t$

The stochastic error terms are not reproduced at this time. The endogenous variables are: C_t, I_t, O_t, Y_t, M_t^d, M_t^s, Y_t^d, r_t^s, r_t^1. There are also eight predetermined variables: C_{t-1}, M_{t-1}, G_t, E_t, $(C_{t-1} - C_{t-2})$, I_{t-1}, r_t^d, B_t. The order condition can be applied to the nine equations of the model. It can be seen that all the equations meet the order condition of identifiability.

Estimation Procedure

The test of identification provides some insight into the method that should be used to estimate the structural parameters. In this case, since the model is overidentified, it is best to use a simultaneous equation method for estimation purposes instead of the ordinary least-squares procedure. In a simultaneous system it is well known that even though the ordinary least-squares method has the property of minimum variance, all the classical conditions for estimation are not satisfied. To be exact, in some equations the variables that serve as regressors are jointly determined with the regressand. Therefore, these regressors cannot be said to be independent of the contemporaneous disturbance term and the ordinary least-squares procedure will lead to inconsistent estimates. Reliance cannot be placed upon reduced-form estimates either, for in the general case of over-identification, unique estimates of structural coefficients cannot be obtained from the values of the reduced-form estimates.

A structural method of estimation, therefore, was more desirable to use than the ordinary least-squares method. Also, it was felt that because additional refinements were to be made in estimation, one desirable property of the estimation procedure chosen should be the efficiency of the estimators. The three-stage least-squares procedure was chosen primarily for this reason. This procedure yields estimates that are asymptotically normal, and asymptotically more efficient than the two-stage least-squares estimators.[2]

The three-stage least-squares estimator is considered to be a full-information estimator because it takes into account all parameters in computing the structural equations. It is for this reason that the estimates are more efficient than two-stage least-squares estimates that do not take account of all the parameters in the system.

Some objections have been raised about the use of full-information methods. One such problem is misspecification. However, these objections have usually been based upon

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[2]Carl F. Christ, Econometric Models and Methods (New York: John Wiley & Sons, Inc., 1966), p. 449.

Monte Carlo studies of the small sample properties of the various estimators.[3] Since the time period used in this thesis contains 50 sample points, these objections were not considered to be as serious as they might be in a smaller sample.

The three steps of the three-stage least-squares procedure are as follows. First, the full reduced-form system is estimated. Second, the two-stage least-squares estimates are computed and the residuals are estimated. These residuals are then used to compute the variance-covariance matrix of the structural equations of the system. Finally, this variance-covariance matrix is used to obtain the generalized least-squares estimates of the structural parameters.[4]

Autocorrelation

In early tests of the model it was apparent that all of the structural equations exhibited a significant amount of autocorrelation as shown by the Durbin-Watson statistic. This is a very common phenomenon when quarterly data are used. A desirable refinement of the estimation procedure would be to correct the estimates for the presence of autocorrelation.[5]

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[3]J. Johnston, op. cit., pp. 275-295.

[4]Arthur S. Goldberger, op. cit., pp. 346-352.

[5]There exists a problem in this respect, however, in that very little is known about the joint presence of autocorrelation and simultaneous-equation complications. See, for example, J. Johnston, op. cit., pp. 294-295.

The general method of correction uses the assumption of a first-order autoregressive scheme. That is, the postulated relationship is

$$(5.10) \qquad Y_t = \alpha + \beta X_t + u_t$$

where Y_t and X_t are two sets of time series data and u_t is a stochastic disturbance term. In this case, the disturbance term follows the first-order scheme

$$(5.11) \qquad u_t = \rho u_{t-1} + \varepsilon_t$$

where ρ is the coefficient of correlation between successive disturbance terms and ε_t is a stochastic disturbance term satisfying the classical assumptions:

$$(5.12) \qquad \begin{aligned} E(\varepsilon_t) &= 0 \\ E(\varepsilon_t \; \varepsilon_{t+s}) &= \sigma^2_\varepsilon \text{ if } s = 0 \\ &= 0 \text{ if } s \neq 0. \end{aligned}$$

Lagging (5.10) one period and multiplying by ρ gives the following relationship.

$$(5.13) \qquad \rho Y_{t-1} = \rho\alpha + \beta\rho X_{t-1} + \rho u_{t-1}$$

If (5.13) is subtracted from (5.10) we get

$$(5.14) \qquad Y_t - \rho Y_{t-1} = \alpha(1 - \rho) + \beta(X_t - \rho X_{t-1}) + \varepsilon_t .$$

Since ε_t satisfies the properties of the classical model, estimation can proceed along the usual lines with $(Y_t - \rho Y_{t-1})$

and $(X_t - \rho X_{t-1})$ serving as the dependent and independent variable, respectively.

In the three-stage procedure, least-squares estimates were made of the individual structural equations to obtain an estimate of ρ for each equation. The variables were then transformed as in (5.14) for use in the three-stage process. After this transformation was made, in all cases except one, the hypothesis that significant autocorrelation existed in the various structural equations could be rejected at a 5% level of significance according to the Durbin-Watson statistic. One should note, however, that several equations contain lagged dependent variables. Under classical conditions this tends to bias the Durbin-Watson statistic towards two.[6]

Statistical Estimates

The three-stage least-squares estimates of the structural equations are presented below. The data used in computing these estimates are quarterly and seasonally adjusted covering the time period from the third quarter of 1953 to the fourth quarter of 1965. This period begins at the close of the Korean conflict and ends with the large expansion of

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[6]Marc Nerlove and Kenneth F. Walis, "Use of the Durbin-Watson Statistic in Inappropriate Situations," Econometrica Vol. 34 (January 1966), p. 235. This applies, of course, to a situation where the ordinary least-squares technique is used. As was noted in footnote 5, little is known of the properties of these statistics when more than one problem exists.

defense expenditures for the Vietnam War. Data are expressed in current dollars. The sources of the data appear in Appendix B.

$$(5.15)\qquad Y_t = C_t + I_t + G_t + E_t - O_t$$

$$(5.16)\qquad C_t = -37.449 + \underset{(.007)}{.242}\, Y_t^d + \underset{(.007)}{.702}\, C_{t-1} + \underset{(.104)}{.315}\, M_t + \underset{(.119)}{.046}\, M_{t-1}$$

$$R^2 = .9469 \qquad \text{D.W.} = 1.950$$

$$(5.17)\qquad I_t = 6.166 + \underset{(.018)}{.060}\, Y_t + \underset{(.249)}{.502}\, (C_{t-1} - C_{t-2}) - \underset{(1.815)}{3.301}\, r_{t-2}^l + \underset{(.097)}{.663}\, I_{t-1}$$

$$R^2 = .9469 \qquad \text{D.W.} = 1.950$$

$$(5.18)\qquad Y_t^d = .67\, Y_t$$

$$(5.19)\qquad O_t = -1.203 + \underset{(.000008)}{.048}\, Y_t$$

$$R^2 = .8633 \qquad \text{D.W.} = 2.282$$

$$(5.20)\qquad r_t^l = 1.650 + \underset{(.001)}{.201}\, r_t^s + \underset{(.000002)}{.003}\, Y_t$$

$$R^2 = .5431 \qquad \text{D.W.} = 2.063$$

$$(5.21)\qquad r_t^s = 15.569 + \underset{(.00004)}{.040}\, Y_t - \underset{(.013)}{.230}\, M_t^d$$

$$R^2 = .4559 \qquad \text{D.W.} = 1.578$$

$$(5.22)\qquad M_t^s = 43.219 + \underset{(.082)}{.890}\, r_t^s + \underset{(.159)}{.208}\, r_t^d + \underset{(.007)}{1.832}\, B_t$$

$$R^2 = .9320 \qquad \text{D.W.} = 1.307$$

(5.23) $M_t^s = M_t^d$

Figures in parenthesis directly below the estimated coefficients of the various parameters are the (asymptotic) standard errors of the coefficients. R^2 is the coefficient of determination and D. W. is the Durbin-Watson statistic relating to a given structural equation. In all equations except (5.22) it appears that autocorrelation has been removed by the use of the transformation described in the preceding section.

Several alterations were made in computation to adjust for difficulties that arose during the estimation procedure. For example, in equation (5.18) disposable personal income was taken to be two-thirds of Gross National Product. In earlier testing, in every case results indicated that the coefficient of Y_t was 0.67 and the intercept term was not significantly different from zero. However, ρ, the coefficient of correlation between successive disturbance terms, was estimated to be very close to 1.00. Since the estimated intercept term is equal to the true estimate of the intercept term multiplied by $(1 - \rho)$, as shown in equation (5.14) above, when the intercept term is corrected, the true estimate becomes very large, approaching infinity as ρ approaches one. Consequently, the identity in (5.18) was used in place of the actual estimate.

Further alterations were made in the investment function, here shown as equation (5.17). The long-term rate of interest, lagged two quarters, was used rather than the contemporaneous value. In several trial estimates of the model, the coefficient for the long-term rate carried the wrong sign and/or was not significantly different from zero when either the current value or a one-quarter lag was used. As presented in (5.17) the coefficient has the appropriate sign and is significantly different from zero at the 10% level of significance. These results are consistent with the evidence in other papers that investment has a lagged response with respect to the rate of interest.

The lagged value of investment was also substituted for the trend variable. It was hypothesized above that trend would help to account for induced technological change. The presence of trend influenced the sign of accelerator variable $(C_{t-1} - C_{t-2})$. That is, the sign of this coefficient became negative. It was found that with this coefficient negative and the interest rate coefficient positive, the estimated model was not dynamically stable. Consequently, the lagged value of investment expenditures was used to pick up the effect of induced technological change.

Individual Equations

The complete model will be examined later in regard to the relative strengths and stability relationships of the various policy parameters. It is interesting at the present time to consider the relative strengths and stability relationships of the individual equations. This can lead to some knowledge of the transmission process.

It is possible for monetary policy to affect aggregate activity in two ways. One path is through consumption expenditures as exhibited in equation (5.16), while a second one is through investment expenditures. This latter path can be achieved either indirectly in terms of the effect on consumption expenditures and hence through the accelerator, or directly through the influence on interest rates. In either case, monetary policy seems to work primarily with a lag.

According to the estimates of the model, monetary policy can affect consumption expenditures directly through changes in the money supply. The contemporaneous value of the money supply possesses a regression coefficient significantly different from zero, while the lagged value does not. It is apparent that the money supply is not as important an explanatory variable as either disposable personal income or lagged consumption expenditures in terms of the t-values of their coefficients. Particularly because of the importance of the lagged consumption variable, it would seem that consumption expenditures adapt fairly slowly to changing economic conditions. This is what is postulated by the permanent income hypothesis. However, it does appear that monetary policy does have some significant contemporaneous influence on these spending decisions.

The influence of monetary policy can be carried to other variables through consumption expenditures. These expenditures affect final sales which are relevant for investment decisions. It has been postulated in this thesis that the change in final sales can be represented in the accelerator variable $(C_{t-1} - C_{t-2})$. This channel of influence operates with a lag.

The second means of influencing investment expenditures is through variations in the long-term interest rate. It is the long-term rate that is most important for business investment decisions. However, the only way the monetary authorities can alter this rate is through the term structure, that is, by altering short-term rates first. The relationship between long-term rates and short-term rates is highly significant. However, equation (5.20) shows that movements in short-term rates or the level of aggregate economic activity do not explain all of the variation in long-term rates. Another loose link from the standpoint of policy seems to be the control of the short-term rate. As can be seen in equation (5.21), the relationship between the money supply and short-term interest rate is not exceptionally close. This result coincides with findings elsewhere.[7] Consequently, the

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[7]Note has been made on previous occasions concerning the absence of a relationship between the money supply and the rate of interest if the demand for money equation is inverted. See, Gregory C. Chow, "Multiplier, Accelerator, and Liquidity Preference in the Determination of National Income in the United States," The Review of Economics and Statistics, XLIX (February 1967), p. 4.

transmission path of influence running through interest rates seems to be somewhat weak. Even if the monetary authorities can affect the long-term rate, the first significant effect on investment spending seems to be after a two-quarter lag.

One final point should be made concerning monetary policy. In the model under discussion, the money supply represents the relevant variable for economic decisions. However, equation (5.22) shows that it is reasonable to treat the money supply as an endogenously determined variable. Much of the movement in the money supply is a result of the monetary authorities who alter the level of the adjusted monetary base. However, the short-term interest rate also enters into the money supply equation significantly; and since the level of short-term rates is influenced by the level of economic activity (as is shown in equation (5.21)), it is very apparent that the control of the money supply by the monetary authorities is far from complete.

Government expenditures enter the economy by directly influencing incomes or the production of goods and services. The total effect of these expenditures, however, is felt through the multiplier process. In terms of consumption expenditures, the multiplier will be dampened by income taxes. Taxes enter into the model in an implicit way as described by the relationship of Gross National Product to disposable personal income (equation (5.18)). That is, a dollar increase in government expenditures will result in a dollar increase in Gross National Product, but will only result in a $.67 increase in disposable personal income.

Government expenditures will also have a multiplier effect on investment expenditures. First, the level of economic activity will affect investment expenditures directly as Gross National Product enters into the investment function. Secondly, government expenditures also influence consumption expenditures and, consequently, the accelerator.

There are two repercussions which tend to lower the total government multiplier over time. An increase in government expenditures which raises Gross National Product also increases imports. This has a negative effect on Gross National Product and, consequently, on consumption and investment expenditures. Aggregate activity, as represented by Gross National Product, also affects the level of interest rates so that some feedback will be registered on investment expenditures.

It might be noted that by influencing the level of interest rates, government expenditures will also influence the money supply in the same direction. This has one direct implication in that these changes in the money supply will have effects on spending decisions that reinforce the effect of the government expenditures. A second, less apparent implication is that if the monetary authorities attempt to maintain stable credit markets, changes in interest rates, caused by changes in government expenditures, could induce the monetary authorities to change the monetary base. An unstable market in this case would be one that experienced large fluctuations in market rates of interest. Consequently, there could be no change in interest rates, but a change in the monetary base which would result in a change in the money supply. In this case, the monetary base would not be an exogenous variable.[8]

The estimated structural equations can be solved for the level of Gross National Product, giving a reduced-form equation. The coefficients of this equation are called "impact multipliers" because they measure the immediate impact of exogenous and lagged endogenous variables on the current value of Gross National Product. The reduced form is:

$$(5.24) \quad Y_t = -18.556 + .860\, C_{t-1} + .067\, r_t^d + .586\, B_t + .056\, M_{t-1} + .614\, (C_{t-1} - C_{t-2}) - 4.039\, r_{t-2}^1 + .812\, I_{t-1} + 1.225\, G_t + 1.225\, E_t.$$

In this case, a $1 billion increase in the adjusted monetary base would result in a $586 million increase in Gross National Product in the same quarter the base increased. A $1 billion increase in government expenditures would result

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[8]See, John H. Wood, "A Model of Federal Reserve Behavior," in George Horwich, Monetary Process and Policy: A Symposium (Homewood, Ill., Richard D. Irwin, 1967), pp. 135-166, for an interesting study of endogenous policy variables.

in a \$1.225 billion increase in Gross National Product the same quarter the increase in government expenditures took place.

To put things on a somewhat comparable basis, a \$1 billion quarterly increase in Gross National Product would require approximately a \$800 million increase in government expenditures or approximately a \$1.7 billion increase in the adjusted monetary base.

In terms of the relative stability of the transmission process, it is hard to arrive at any strong conclusions. Due to the weakness of the path through interest rates and the sluggishness of changes in consumption expenditures in response to changes in the money supply it would appear that as a first approximation, monetary policy may be the weaker of the two relationships.

In terms of the impact multipliers, fiscal policy clearly merges as the stronger short-run instrument. During the time period under review, the adjusted monetary base did not increase in any quarter by \$1.7 billion. In fact, it increased by \$1 billion only once in the entire period, and that was in the fourth quarter of 1965.

By contrast, the necessary growth of government expenditures necessary to alter the GNP by \$1 billion could be considered moderate in terms of the actual changes that took place in the time period under review. In fact, quarterly changes of at least \$800 million occurred quite frequently.

Dynamic Aspects of the Model

It is hard to draw conclusions about the relative effects of monetary and fiscal policy when the model we have estimated covers the whole period of time under review. It is desirable, therefore, to investigate the dynamic properties of the model and to observe its short-run properties and multipliers.

The reduced form of the model, presented above as equation (5.24), can be altered to obtain the final form[9] of the equation or what has also been called the fundamental dynamic equation.[10] This equation is derived by successive substitutions for the lagged endogenous variables in the reduced-form equation. The final result will show the current endogenous variable of interest as a function of its own lagged values and current and lagged values of the exogenous variables. The final form for Gross National Product is presented as:

$$
\begin{aligned}
(5.25)\quad Y_t = {} & -9.145 + 1.668\, Y_{t-1} - 0.743\, Y_{t-2} + 0.028\, Y_{t-3} \\
& + 0.586\, B_t - 0.009\, B_{t-1} - 0.024\, B_{t-2} \\
& - 0.242\, B_{t-3} + 1.225\, (G_t + E_t) \\
& - 1.671\, (G_{t-1} + E_{t-1}) + 0.570\, (G_{t-2} + E_{t-2}).
\end{aligned}
$$

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[9] Arthur S. Goldberger, op. cit., p. 374.

[10] Jan Kmenta and Paul E. Smith, "Autonomous Expenditures vs. Money Supply: An Application of Dynamic Multipliers," Econometrics Workshop Paper No. 6604, Michigan State University, February 1967, p. 15.

The coefficients of the various policy variables are called "delay multipliers." They show the effect on the expectation of current Gross National Product of a change in any variable in a particular period. For example, a \$1 billion increase in government expenditures two quarters in the past will result in a \$570 million increase in the expectation of Gross National Product in the current quarter.

The final form can also be used to determine the inherent stability of the model. In this case, an "auxiliary equation" is obtained by putting all terms that involve Gross National Product (Y) on the left-hand side of the equation and setting the right-hand side equal to zero. The resulting difference equation is then solved and the largest root of the equation determines whether the system is stable or not. In the present case, the auxiliary equation becomes:

$$(5.26) \quad Y_t - 1.668\, Y_{t-1} + 0.743\, Y_{t-2} - 0.028\, Y_{t-3} = 0.$$

This is solved for the following roots:

$$\lambda_1 = 0.038$$
$$\lambda_2 = 0.815 + 0.118\, i$$
$$\lambda_3 = 0.815 - 0.118\, i.$$

It appears that the model is stable since the largest real root and the modulus of the conjugate complex roots are less than unity in absolute value. Because of the presence of complex roots the system will oscillate toward its equilibrium value. Consequently, the sources of instability in the system appear to be either from random disturbances or from changes in the exogenous policy variables.

The final form can be put to a second use. From this equation dynamic multipliers can be derived for the time path of Gross National Product. These multipliers are obtained by establishing the initial conditions of the reduced form and then substituting in the value for lagged components of Gross National Product. Once this is done, the time period is increased by one and substitution takes place again. This can be carried on for as long as the investigator feels it is desirable. The coefficients attached to the various current and lagged exogenous variables are the "dynamic multipliers." The sum of these for any particular variable gives the intermediate- or long-run multiplier for that variable.

The dynamic multipliers have been computed for the adjusted monetary base and government expenditures. These are presented in Table 5-1. The values were not computed for the discount rate. In the first place, the coefficient for the current value of the discount rate has the "wrong" sign. It should be emphasized, however, that this coefficient was not significantly different from zero. Thus the information in the sample suggests that there is not a significant current-quarter response in the money supply to changes in the discount rate.

Since this thesis is primarily concerned with short-run behavior the values of the multipliers were computed only up

TABLE 5-1. Dynamic Multipliers for the Time Path of Gross National Product

Lag s	Coefficient of B_{t-s}	Coefficient of G_{t-s}
0	+ 0.586	+ 1.225
1	0.968	0.371
2	1.156	0.279
3	0.982	0.224
4	0.807	0.176
5	0.649	- 0.073
6	0.510	- 0.246
7	0.391	- 0.352
8	0.291	- 0.405

to an eight-quarter lag. Also, if monetary and fiscal policy are carried out each quarter, the long-run effects are not too significant if the system is stable, for the multipliers should tend either to oscillate or to follow a monotonic path towards zero. However, the intermediate-term multipliers can be quite significant for the fulfillment of policy. If, for example, the multipliers oscillate widely, future policy might be more difficult to implement because of the repercussions of present policy. If the multipliers change in a relatively smooth way or oscillate only mildly, future policy will be easier to implement and its effects will be more easily projected.

As shown in Table 5-1, the dynamic multipliers of both policy variables tend to change in a relatively moderate way over time. The multipliers for the adjusted monetary base rise to a peak after a two-quarter lag and then decline in a smooth fashion. Because of the adjustments in the multipliers, it would appear that future policy could take into account past policy and be implemented without any problem of offsetting or irregular movements in the economy due to these previous policy decisions. It is obvious, however, that a decision to reverse policy quickly would require a greater than normal change in the policy variable under discussion.

The dynamic multipliers of government expenditures show that the greatest impact is felt in the quarter in which these expenditures are undertaken. After this period the value of the multiplier declines considerably. The multiplier tends to oscillate around zero if their values are estimated for more than eight quarters.

The major implication to be derived from these figures is that government expenditures have relatively little effect on the economy after the quarter they are undertaken. This can imply two things. First, the total impact of government expenditures can be felt rather quickly. Second, policymakers face very little difficulty in implementing future policy because of the cumulative effect of past fiscal policy. Therefore, fiscal policy, in terms only of its effect on the economy, can be reversed quickly and does not encounter, to any great extent, the problem of offsetting past policy decisions.[11]

In terms of relative effects, the impact of a $1 billion increase in government expenditures is greater than a $1 billion increase in the adjusted monetary base. The effect is still greater one quarter after the initial

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[11]It should be noted that these results concerning the lagged effects of monetary and fiscal policy are similar to the results obtained by Friedman and Meiselman. They found that autonomous expenditures were most highly correlated with induced expenditures in the time period in which they were undertaken. The money supply, however, was most highly correlated with induced expenditures when it was lagged two quarters. Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in B. Fox and E. Shapiro, Stabilization Policies (Englewood Cliffs, N. J.: Prentice-Hall, 1963), pp. 209-210. This coincides, to some extent, with these policy variables having the greatest influence on Gross National Produce in any one quarter.

changes. After that, however, the cumulative strength of changes in the adjusted monetary base becomes much larger than that of government expenditures. At the end of a year the cumulative multiplier for the adjusted monetary base is 4.499, while it is 2.274 for government expenditures. After two years the cumulative multipliers are 6.340 for the adjusted monetary base and 1.198 for government expenditures.

In judging the influence of these multipliers on aggregate demand, the relative size of changes in the two policy variables must be taken into consideration. During the time period under review, the adjusted monetary base did not change by more than $1 billion in any one quarter. As was mentioned above, the largest change was $1 billion in the fourth quarter of 1965. If the monetary base changed by $500 million, this would have the effect of changing Gross National Product by only $2.25 billion at the end of a year's time. On the other hand, government expenditures changed by more than $1 billion in one quarter quite frequently.

Summary

Assuming that the estimated model is a reasonable short-run specification of aggregate demand, several conclusions can be drawn from the above results:

(i) The linkages between monetary variables and Gross National Product are somewhat loose. Monetary policy works through both consumption expenditures and investment expenditures. However, the relationship with consumption is not very strong and that with investment occurs only with some passage of time. The current-period transmission process operating through interest rate variables is very weak.

(ii) Government expenditures work quickly on consumption and investment expenditures through direct increases in the demand for goods and services and wages and salaries. Government expenditures exert repercussions on these expenditures through feedbacks that occur in imports and interest rates.

(iii) Government expenditures appear to have the greater impact on Gross National Product in the short run, while the monetary variables may have the greater overall long-run influence. However, this conclusion must be carefully interpreted in terms of the relative size of changes in the two variables.

(iv) Monetary and fiscal policy both seem to work themselves out in fairly regular patterns. However, because of the more substantial long-run influence of monetary policy, it would seem to be more difficult to reverse the direction of its impact on aggregate demand.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS FOR FURTHER RESEARCH

Summary of Work Completed

The main purpose of this study is to investigate the relative effects of various exogenous variables on national income. Whereas, the original research into this area postulated simple linear reduced-form models, this thesis attempts to carry the discussion into the more complete framework of a nine-equation econometric model. In so doing, it is hoped that a greater understanding of the relative importance of the exogenous variables can be achieved.

The major conclusion of the thesis is that there is still no clear-cut answer to the question concerning the most important policy variable or the most stable functional relationship. As a result, one should probably adopt the more moderate position that both monetary and fiscal policy are important and that more research needs to be devoted to observing their combined effects on the economy rather than in trying to isolate their individual effects. Some tentative conclusions, however, can be drawn from the above discussion that will at least arrange the primary points in some coherent form.

(i) Aggregation. Extreme care must be used in interpreting the results of single-equation tests derived from very elementary models, due to the heroic aggregation necessary for such models. This seems to have been the major problem encountered in the early work done in this area. For example, no discussant seemed to agree on the appropriate definition of autonomous expenditures. The conclusion drawn from the tests, therefore, depended heavily upon which definition was used. As a result, the early discussions led to no verdict. However, they did clarify some of the problems involved in such a research effort.

(ii) Stability. Both relationships, the income velocity of circulation and the investment multiplier are unstable in an absolute sense. In fact, the single-equation models would terrify any decision maker who might use them for policy considerations.

(iii) Control of Exogenous Variables. Friedman and Meiselman draw satisfaction from the fact that the money supply is easily controlled by the monetary authorities, whereas any of the measures of autonomous expenditures are not under the control of Federal authorities. There is, of course, some question as to the degree of control the monetary authorities have over the money supply. As to autonomous expenditures, there is no question about the absence of direct control the Federal Government has over net private domestic investment and the net export balance. More will be said on this point in the second section of this chapter.

(iv) Transmission Process. This point brings in the use of the complete model. It is in this context that some of the linkages between policy variables and endogenous variables can be discussed. As pointed out in Chapter V, the transmission of shocks from fiscal policy variables to aggregate activity seems to be more direct than those of monetary policy. Also, the immediate impact is greater. In fact, it would appear that there is a great deal of room for variation in the final relationship between the adjusted monetary base and Gross National Product. Hence, one could expect considerable variation in the velocity of circulation.[1]

(v) Relative Strengths of the Two Policy Variables. In terms of the initial impact on the economy, government expenditures seem to have a greater force initially and for one quarter thereafter. The adjusted monetary base surpasses the total influence of government expenditures in the second quarter and its effect remains larger.

Care should be taken in interpreting these effects, because the quarter-to-quarter change in government

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[1]The velocity of circulation is here defined as Gross National Product/Adjusted Monetary Base. If the money supply is closely related to the adjusted monetary base, then what is true for this value will also be true for Gross National Product/money supply. If the money supply is not closely related to the adjusted monetary base, then the velocity of circulation loses its importance for monetary actions.

expenditures usually exceeds the quarter-to-quarter change in the adjusted monetary base. A $1 billion change in government expenditures is not the average equivalent policy of a $1 billion change in the adjusted monetary base.

(vi) Reversibility of Policy. It is apparent in judging the dynamic effects of monetary and fiscal policy that it is much easier to reverse the effects of fiscal policy than to reverse those of monetary policy. The effect of fiscal policy is felt primarily in the quarter in which it is undertaken. The effects of monetary policy build up to a peak and then decline slowly. Consequently, a reversal of the effects of monetary policy must overcome the influences of past policy. This problem presents possibilities for further study into the lag in effect of monetary policy.

(vii) Relation of Money to Gross National Product Over Time. The conclusion reached in (vi) above can be used to account for some of the observed relationship between the money supply and Gross National Product. Because the effects of monetary policy work over time, this would mean that a growing money supply would provide a growing effect on Gross National Product, independent of the current monetary policy. What changes is the income velocity of money. In this case it would increase. This is just what Friedman has found. Income velocity increases in the boom time of a cycle and falls in the contraction.[2] He explains this result in

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[2]Milton Friedman, "The Demand for Money: Some Theoretical and Empirical Results," The Journal of Political Edonomy, Vol. 67 (August 1959), p. 329.

terms of the permanent income hypothesis. However, it can easily be explained in terms of the past effects of a growing money supply. That is, a relatively constant growth in the monetary variable has a cumulative effect on the growth of Gross National Product.

It also appears that one could expect that after a change took place in policy, for example, from a positive growth rate to a negative growth rate, and after the past influence of monetary policy is finally overcome, there would be a drastic change in the current relationship between the money supply and Gross National Product. The velocity of circulation would in this case fall, leading to the conclusion that there had been a shift in the demand for money when there actually had not been. This certainly is an interesting hypothesis and worthy of further study.

Recommendations for Further Study in the Area of Single-Equation Models

The simple linear, reduced-form model, however, is not completely without use. In the early work done in this area, the reduced forms were derived from the very simplest models that exemplified the characteristics of the theories under discussion. The linear models suffer from many deficiencies, such as simultaneous equation bias. However, the use of these simple models represents the only way, at present, to test short-period movements of data over many different time periods. More expanded models take up degrees of freedom that are very vital in computing the annual data when only ten sample points are used. Also, the larger models appear to be quite susceptible to misspecification of the model when small samples are used.[3] Because of this, the minimum variance property of the ordinary least-squares method of estimation becomes quite important. It would seem that additional research could continue in several profitable directions using only the single-equation procedure. These are listed below.

(i) Autonomous Variable. It has been suggested by Pesek[4] that autonomous expenditures should be divided into two components. One component, "private" autonomous expenditures are outside the control of the Federal Government. This is true, at least at the very simple level of aggregation used in these single-equation models. The second component would be a component that could truly be compared with the money supply (or some other monetary variable). This would be "public" expenditures, and preferably those public expenditures undertaken by the Federal Government. This autonomous variable could be either the total of Federal Government expenditures or the Federal Government deficit. The particular form could be as follows:

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[3] J. Johnston, Econometric Methods (New York: McGraw-Hill, 1963), pp. 293-294.

[4] Boris P. Pesek, "Money vs. Autonomous Expenditures: The Quality of the Evidence," Business Economics, III (Spring 1968), p. 29.

$$(6.1) \quad C_t = a + K'A_t^1 + k''A_t^2$$

where C_t is induced expenditures

A_t^1 is private autonomous expenditures

A_t^2 is public autonomous expenditures.

This could be tested in the following form:

$$(6.2) \quad C_t = a' + K''A_t^2 + u_t$$

where $a' = a + K'A_t^1$

and u_t is the normal stochastic error term with zero mean, constant variance and zero covariance. Because of the nature of A_t^1, it would still be independent of u_t, even as a part of the intercept term.

It would be desirable to test (6.2) and compare the results with the velocity of circulation models. This would reduce the test to a comparison of two variables felt by many to be under the control of policymakers.

(ii) The Interest Rate and the Demand for Money. In most studies of the demand for money, other factors are felt to be highly influential. The most commonly used variable in this respect is some measure of "the" interest rate. Many studies have found an interest rate to be highly important in the demand for money,[5] although Friedman has not found this to be

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[5]Henry A. Latané, "Cash Balances and the Interest Rate--A Pragmatic Approach," The Review of Economics and Statistics, Vol. 36 (November 1954), pp. 456-460 and also "Income Velocity and Interest Rates: A Pragmatic Approach," The Review of Economics and Statistics, Vol. 42 (November 1960), pp. 443-449. See also, Allan H. Meltzer, "The Demand for Money:

true in his work.[6] These former studies have shown that movements in the income velocity of circulation seem to be closely related to movements in interest rates.

This is perhaps where the concern of Friedman and Meiselman for the relative stability of the income velocity of circulation can be misleading. There is no doubt that when one looks at the computed values of income velocity (as shown in Appendix A), it changes considerably. In fact, jumps of approximately 10% appear to be quite frequent.[7] It is apparent that something else is needed to help explain these jumps.

This supposedly was one of the main developments of the "Keynesian revolution." The Keynesian approach attempted to explain variations that took place in the velocity of circulation. This is why Keynes himself placed so much emphasis on the rate of interest in the demand for money equation.[8]

The Evidence from the Time Series," The Journal of Political Economy, Vol. 71 (June 1963), pp. 219-246.

[6]Milton Friedman, "The Demand for Money," op. cit., p. 345.

[7]Tobin has called special attention to the fact that velocity changed up to 10% on a year-to-year basis in the vast majority of cases over the 91 years incorporated into Friedman and Swartz's Monetary History of the United States. Therefore, the fact that velocity changes 10% or more over longer periods of time should not be surprising. See, James Tobin, "The Monetary Interpretation of History," The American Economic Review, LV (June 1965), pp. 479-480.

[8]John Maynard Keynes, "The Theory of the Rate of Interest," in W. Feller and B. F. Haley, Readings in the Theory of Income Distribution (Homewood, Ill.: Richard D. Irwin, Inc., 1951), p. 422.

Tobin has postulated that classical economists felt that the interest rate was not needed in the demand for money equation.[9] This was because "the" rate of interest was the marginal productivity of capital. In the classical system, with flexible wages and prices, the system would always return to full employment. Given the technological and behavioral structure, the full employment value of the marginal product of capital was always the same. "The" rate of interest was a constant. Keynes unlocked this problem in attempting to discuss periods of less than full employment. Consequently, "the" rate of interest became a variable again in the demand for money equation.

Most studies of the demand for money have covered an extended period of time. It might prove instructive to include an interest rate variable in the reduced-form quantity theory equation, as tested above, to see if this could help explain some of the short-run variations found in the velocity of circulation.

(iii) Determinants of the Money Supply. A great deal of work has been done in recent years in the area of the supply of money.[10] Friedman himself has contributed to this

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[9]James Tobin, "Money, Capital and Other Stores of Value," The American Economic Review, Papers and Proceedings, Vol. 51 (May, 1961), p. 31.

[10]Karl Brunner, "A Schema for the Supply Theory of Money," International Economic Review, Vol. 2 (January 1961), pp. 79-109 and Karl Brunner and Allan H. Meltzer, "Some Further Investigations of Demand and Supply Functions for Money," The Journal of Finance, Vol. XIX (May 1964), pp. 240-283.

development.[11] Reference has already been made to this work in the derivation of the money supply equation of the complete model used in this thesis. As was mentioned above, the control of this variable by the monetary authorities is not absolute. This presents another desirable path that could be taken in future research. The data are available for the period that has been studied by Friedman and Meiselman.[12] It would be interesting to see if the authorities have as much short-run control over the money supply as is hypothesized by those who consider this variable to be relevant for economic decision making. The evidence from quarterly data in this thesis suggests that the degree of control is not especially great.

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[11]Milton Friedman, *A Program for Monetary Stability* (New York: Fordham University Press, 1959), pp. 105-106 and Milton Friedman and Anna Jacobson Swartz, *A Monetary History of the United States, 1867-1960* (Princeton, N. J.: Princeton University Press, 1963), pp. 776-798.

[12]Milton Friedman and Anna Jacobson Swartz, *op. cit.*, pp. 799-808.

BIBLIOGRAPHY

BIBLIOGRAPHY

Adelman, Irma and Adelman, Frank L. "The Dynamic Properties of the Klein-Goldberger Model," Econometrica, October 1959.

Andersen, Leonall and Jordan, Jerry. "Monetary and Fiscal Actions: Their Relative Importance in Economic Stabilization," Review, Federal Reserve Bank of St. Louis, 50, November 1968.

Ando, Albert and Modigliani, Franco. "The Relative Stability of Monetary Velocity and the Investment Multiplier," The American Economic Review, LV, September 1965.

________. "Rejoinder," The American Economic Review, LV, September 1965.

Board of Governors of the Federal Reserve System. Federal Reserve Bulletin. Board of Governors of the Federal Reserve System, Washington, D. C., 1952.

Brunner, Karl. "A Schema for the Supply Theory of Money," The International Economic Review, Vol. 2, January 1961.

Brunner, Karl and Meltzer, Allan H. "Liquidity Traps for Money, Bank Credit, and Interest Rates," The Journal of Political Economy, Vol. 76, January/February 1968.

________. "Rejoinder to Chase and Hendershott," in G. Horwich, Monetary Process and Policy: A Symposium. Homewood, Ill.: Richard D. Irwin, Inc., 1967.

________. "Some Further Investigations of Demand and Supply Functions for Money," The Journal of Finance, XIX, May 1964.

Cagan, Phillip. Determinants and Effects of Changes in the Stock of Money, 1875-1960. New York: Columbia University Press, 1965.

Chow, Gregory C. "Multiplier, Accelerator, and Liquidity Preference in the Determination of National Income in the United States," The Review of Economics and Statistics, XLIX, February 1967.

Christ, Carl F. "A Short-run Aggregate-demand Model of the Interdependence and Effects of Monetary and Fiscal Policies with Keynesian and Classical Interest Elasticities," The American Economic Review, LVII, May 1967.

________. "A Simple Macroeconomic Model with a Government Budget Restraint," The Journal of Political Economy, Vol. 76, January/February 1968.

________. Econometric Models and Methods. New York: John Wiley and Sons, Inc., 1966.

De Prano, Michael and Mayer, Thomas. "Tests of the Relative Importance of Autonomous Expenditures and Money," The American Economic Review, LV, September 1965.

________. "Rejoinder," The American Economic Review, LV, September 1965.

Dernberg, Thomas F. and McDougall, Duncan M. Macroeconomics, Third Edition, New York: McGraw-Hill.

Duesenberry, James. Income, Savings and the Theory of Consumer Behavior. Harvard University Press, 1949.

Ezekiel, Mordechai and Fox, Karl A. Methods of Correlation and Regression Analysis. New York: John Wiley and Sons, Inc., 1959.

Feige, Edgar. The Demand for Liquid Assets: A Temporal Cross-Section Analysis. Englewood Cliffs, N. J.: Prentice-Hall, 1964.

Friedman, Milton. A Program for Monetary Stability. New York: Fordham University Press, 1960.

________. A Theory of the Consumption Function. Princeton University Press, 1957.

________. "The Demand for Money: Some Theoretical and Empirical Results," The Journal of Political Economy, Vol. 67, August 1959.

Friedman, Milton and Meiselman, David. "Reply to Ando and Modigliani and De Prano and Mayer," The American Economic Review, LV, September 1965.

________. "Reply to Donald Hester," The Review of Economics and Statistics, XLVI, November 1964.

________. "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in B. Fox and E. Shapiro, Stabilization Policies. Englewood Cliffs, N. J.: Prentice-Hall, 1963.

Friedman, Milton and Swartz, Anna Jacobson. A Monetary History of the United States, 1867-1960. Princeton, N, J.: Princeton University Press, 1963.

Fromm, Gary and Taubman, Paul. Policy Simulations with an Econometric Model. Washington, D. C.: The Brookings Institution, 1968.

Goldberger, Arthur S. Econometric Theory. New York: John Wiley and Sons, Inc., 1964.

________. Impact Multipliers and Dynamic Properties of the Klein-Goldberger Model. Amsterdam: North-Holland Publishing Co., 1959.

Hester, Donald. "Keynes and the Quantity Theory: A Comment on the Friedman-Meiselman CMC Paper," The Review of Economics and Statistics, XLVI, November 1964.

________. "Rejoinder," The Review of Economics and Statistics, XLVI, November 1964.

Hicks, J. R. "Mr. Keynes and the 'Classics': A Suggested Interpretation," Econometrica, V, 1939. Reprinted in Readings in the Theory of Income Distribution. Homewood, Ill.: Richard D. Irwin, Inc., 1951.

Johnson, Harry G. "Monetary Theory and Policy," The American Economic Review, LII, June 1962.

Johnston, J. Econometric Methods. New York: McGraw-Hill, 1963.

Keynes, John Maynard. A Treatise on Money, 2 Vols. New York: Harcourt, Brace and Company, 1930.

________. The General Theory of Employment Interest and Money. New York: Harcourt, Brace and Company, 1936.

________. "The Theory of the Rate of Interest," in W. Feller and B. F. Haley, Readings in the Theory of Income Distribution. Homewood, Ill.: Richard D. Irwin, Inc., 1951.

Klein, L. R. Economic Fluctuations in the United States. New York: John Wiley and Sons, Inc., 1950.

Klein, L. R. and Goldberger, A. S. An Econometric Model of the United States, 1929-1952. Amsterdam: North-Holland Publishing Co., 1955.

Kmenta, Jan and Smith, Paul. "Autonomous Expenditures vs. Money Supply: An Application of Dynamic Multipliers," Econometrics Workshop Paper No. 6604, Michigan State University, February 1967.

Latané, Henry A. "Cash Balances and the Interest Rate--A Pragmatic Approach," The Review of Economics and Statistics, Vol. 36, November 1954.

________. "Income Velocity and Inrerest Rates: A Pragmatic Approach," The Review of Economics and Statistics, Vol. 42, November 1960.

Meltzer, Allan H. "The Demand for Money: The Evidence of the Time Series," The Journal of Political Economy, Vol. 71, June 1963.

Nerlove, Marc and Walis, Kenneth F. "Use of the Durbin-Watson Statistic in Inappropriate Situations," Econometrica, Vol. 34, January 1966.

Pesek, Boris P. "Money vs. Autonomous Expenditures: The Quality of the Evidence," Business Economics, III, September 1968.

Pesek, Boris P. and Saving, Thomas R. Money, Wealth and Economic Theory. New York: Macmillan Co., 1967.

Teigen, Ronald. "The Demand for and Supply of Money," in W. L. Smith and R. L. Teigen, Readings in Money, National Income, and Stabilization Policy. Homewood, Ill.: Richard D. Irwin, Inc., 1965.

Theil, H. and Boot, J. C. G. "The Final Form of Econometric Equation Systems," Review of the International Statistical Institute, Vol. 30, 1962.

Tobin, James. "An Essay on Principles of Debt Management," in B. Fox and E. Shapiro, Fiscal and Debt Management Policies. Englewood Cliffs, N. J.: Prentice-Hall, 1963.

________. "Money, Capital and Other Stores of Value," The American Economic Review, Papers and Proceedings, Vol. 51, May 1961.

________. "The Monetary Interpretation of History," The American Economic Review, LV, June 1965.

United States Department of Commerce. Business Statistics, 16th Biennial Edition. United States Department of Commerce, Washington, D. C., 1967.

United States Department of Commerce. Long-term Economic Growth: 1860-1965. Washington, D. C.: U. S. Government Printing Office, 1966.

________. The National Income and Product Accounts of the United States, 1929-1965, Statistical Tables. United States Department of Commerce, Washington, D. C., 1966.

Wold, Herman and Jureen, Lars. Demand Analysis. New York: John Wiley and Sons, Inc., 1951.

Wood, John H. "A Model of Federal Reserve Behavior," in G. Horwich, Monetary Process and Policy: A Symposium. Homewood, Ill.: Richard D. Irwin, Inc., 1967.

Zellner, A., Huang, D. S., and Chau, L. C. "Further Analysis of the Short-run Consumption Function with Emphasis on the Role of Liquid Assets," Econometrica, Vol. 33, July 1965.

APPENDICES

APPENDIX A

RESULTS OF THE FRIEDMAN-MEISELMAN TESTS AND THE CORRECTIONS FOR STANDARD ERROR TERMS

This appendix presents the results of the Friedman-Meiselman tests and the corrections for standard error terms mentioned earlier in the text in Chapter IV. It was also stated that autocorrelation caused the standard errors of the coefficients to be underestimated. Therefore, the proper correction of the standard errors would raise their numerical value and reduce the significance level of the various coefficients.

Since the major interest of this thesis is in the variables that possess the correct sign and are significantly different from zero, the only standard errors corrected were those that related to the coefficients of the policy variables whose estimates had the proper sign; were significantly different from zero at the 5% level of significance; and where there was significant autocorrelation present in the estimated equation. If the estimated coefficient had the wrong sign or was not significantly different from zero, the correction of its standard error was not performed because it would not change any of the conclusions already reached.

In Table A-1, only the estimated coefficients for the policy variables are presented for each equation and for each time period. The results from both sets of data are also presented. The uncorrected standard error terms are in parenthesis directly below the estimated coefficient. Those corrected standard error terms are shown directly below the uncorrected values in those cases where the correction has been performed.

TABLE A-1. The Friedman-Meiselman Results with Corrected and Uncorrected Standard Error Terms

$C = a + kA + VM_2$

Annual Figures	First Set of Data A	First Set of Data M_2	Second Set of Data A	Second Set of Data M_2
1897-1958	- .425	+ 1.38		
	(.243)*	(.047)		
		(.178)		
1897-1908	- .239	1.690		
	(.138)*	(.052)		
1903-1913	- .057	+ 1.91		
	(.159)*	(.061)		
1908-1921	+ .181	1.750		
	(.126)	(.064)		
1913-1920	+ .287	1.749		
	(.274)*	(.158)		
1920-1929	+ .238	1.295		
	(.300)*	(.149)		
1921-1933	+ .794	1.137		
	(.133)	(.150)		
1929-1939	+ 1.422	.493	+ 1.583	.653
	(.184)	(.165)	(.590)	(.371)
			(1.191)⌿	
1933-1938	+ .437	1.127	+ .383	+ 1.126
	(.539)*	(.344)	(.486)*	(.243)
		(.493)		(.408)
1938-1953	- .468	1.329	- .509	+ 1.333
	(.383)*	(.107)	(.407)*	(.114)
		(.289)		(.308)
1939-1948	- .376	+ 1.031	- .455	1.029
	(.257)*	(.094)	(.253)*	(.090)
		(.135)		(.124)
1948-1957	- .643	+ 1.480	+ .663	+ 2.114
	(.339)*	(.082)	(.697)*	(.166)
		(.284)		(.249)
1929-1958	+ .453	+ 2.103	- .862	+ 1.519
	(.670)	(.186)	(.357)*	(.089)
		(.267)		(.279)

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

⌿ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

C = α + KA Annual Figures	First Set of Data A	Second Set of Data A
1897-1958	+ 5.162	
	(.578)	
	(1.814)	
1897-1908	+ 2.562	
	(1.121)	
	(1.985)⌿	
1903-1913	+ 2.427	
	(1.459)*	
1908-1921	+ 2.407	
	(.765)	
	(1.424)⌿	
1913-1920	+ 2.606	
	(.822)	
	(1.082)	
1920-1929	1.602	
	(.818)*	
1921-1933	+ 1.385	
	(.266)	
	(.641)	
1929-1939	+ 1.898	+ 2.498
	(.126)	(.312)
	(.174)	(.553)
1933-1938	+ 2.134	+ 2.453
	(.283)	(.467)
	(.360)	(.644)
1938-1953	+ 1.323	+ 1.865
	(1.226)*	(1.151)*
1939-1948	+ .334	+ .494
	(.990)	(.994)
1948-1957	+ 3.848	+ 7.131
	(.823)	(2.187)
	(2.583)⌿	(3.873)⌿
1929-1958	+ 6.390	+ 3.946
	(1.716)	(.748)
	(2.365)	(2.347)⌿

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

⌿ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$C = \alpha + VM_2$

Annual Figures	First Set of Data M_2	Second Set of Data M_2
1897-1958	+ 1.315	
	(.030)	
	(.114)	
1897-1908	+ 1.634	
	(.044)	
1903-1913	+ 1.900	
	(.050)	
1908-1921	+ 1.809	
	(.051)	
1913-1920	+ 1.875	
	(.103)	
1920-1929	+ 1.357	
	(.124)	
1921-1933	+ 1.663	
	(.248)	
	(.540)	
1929-1939	+ 1.596	+ 1.527
	(.226)	(.229)
	(.456)	(.552)
1933-1938	+ 1.394	+ 1.303
	(.093)	(.090)
	(.188)	(.196)
1938-1953	+ 1.280	+ 1.262
	(.101)	(.101)
	(.317)	(.317)
1939-1948	+ .996	+ .976
	(.097)	(.096)
	(.163)	(.161)
1948-1957	+ 1.367	+ 2.230
	(.058)	(.113)
	(.220)	(.170)
1929-1958	+ 2.201	+ 1.351
	(.112)	(.059)
	(.168)	(.223)

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

≠ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$Y = a + V'M_2$

Annual Figures	First Set of Data M_2	Second Set of Data M_2
1897-1958	+ 1.469 (.030) (.094)	
1897-1908	+ 1.867 (.081)	
1903-1913	+ 2.089 (.115)	
1908-1921	+ 2.137 (.140) (.201)	
1913-1920	+ 2.312 (.217)	
1920-1929	+ 1.618 (.220)	
1921-1933	+ 2.325 (.508) (1.371)/	
1929-1939	+ 2.372 (.370) (.805)	+ 2.080 (.306) (.618)
1933-1938	+ 2.006 (.155) (.337)	+ 1.765 (.158) (.237)
1938-1953	+ 1.385 (.102) (.246)	+ 1.402 (.101) (.244)
1939-1948	1.089 (.116) (.174)	+ 1.092 (.102) (.153)
1948-1957	+ 1.543 (.056) (.176)	+ 2.399 (.144) (.206)
1929-1958	+ 2.418 (.140) (.193)	+ 1.545 (.054) (.169)

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

/ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$C = a + kA + VM_2 + BP$

Annual Figures	First Set of Data A	First Set of Data M_2	Second Set of Data A	Second Set of Data M_2
1897-1958	- .531	1.096		
	(.211)	(.075)		
		(.260)		
1897-1908	- .302	1.928		
	(.154)	(.258)		
1903-1913	- .050	1.751		
	(.167)*	(.287)		
1908-1921	- .159	.967		
	(.100)*	(.165)		
1913-1920	- .225	+ .618		
	(.127)*	(.193)		
1920-1929	+ .153	1.360		
	(.327)*	(.175)		
		(.241)		
1921-1933	+ .365	1.219		
	(.290)*	(.147)		
1929-1939	+ .937	.659	.821	.654
	(.264)	(.154)	(.227)	(.128)
			(.264)	(.149)
1933-1938	- 1.009	1.256	+ .056	+ .933
	(.713)*	(.226	(.458)*	(.239)
				(.315)
1938-1953	- .347	- .255	- .335	- .199
	(.168)*	(.216)*	(.181)*	(.213)*
1939-1948	- .394	+ .045	- .413	+ .136
	(.061)	(.094)	(.067)*	(.095)*
1948-1957	- .478	+ .510	+ .557	2.060
	(.275)*	(.253)	(1.446)*	(.657)
		(.876)/		(.986)
1929-1958	- .034	+ 1.79	- .562	.513
	(.983)*	(.493)	(.297)*	(.262)*
		(.740)		

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

/ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

C = a + kA + BP

Annual Figures	First Set of Data A	Second Set of Data A
1897-1958	+ .524 (.428)*	
1897-1908	+ .316 (.347)*	
1903-1913	+ .138 (.385)*	
1908-1921	- .498 (.164)	
1913-1920	- 2.196 (.189)	
1920-1929	+ 1.66 (.813) (1.440)⌿	
1921-1933	+ 1.658 (.679) (1.370)⌿	
1929-1939	+ 1.875 (.263) (.362)	+ 1.739 (.281) (.498)
1933-1938	+ 1.621 (1.767)*	+ .844 (.983)*
1938-1953	- .381 (.168)*	- .376 (.175)*
1939-1948	- .392 (.058)	- .399 (.071)*
1948-1957	- .293 (.274)*	- 2.698 (1.514)*
1929-1958	- 1.580 (1.464)*	- .301 (.278)*

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

⌿ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$C = \alpha + vM_2 + BP$

Annual Figures	First Set of Data M_2	Second Set of Data M_2
1897-1958	+ 1.032 (.073) (.277)	
1897-1908	+ 1.658 (.250)	
1903-1913	+ 1.735 (.266)	
1908-1921	1.118 (.144) (.291)	
1913-1920	+ .779 (.204)	
1920-1929	+ 1.41 (.133)	
1921-1933	+ 1.319 (.128)	
1929-1939	+ 1.112 (.135) (.194)	+ 1.022 (.124) (.163)
1933-1938	+ 1.044 (.196)	+ .946 (.176) (.243)
1938-1953	- .333 (.238)*	- .295 (.225)*
1939-1948	+ .023 (.244)*	+ .052 (.236)*
1948-1957	+ .364 (.247)*	+ 1.879 (.429) (.615)
1929-1958	+ 1.793 (.411) (.617)	+ .289 (.245)*

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

⊬ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$Y = a + V' M_2 + BP$

Annual Figures	First Set of Data M_2	Second Set of Data M_2
1897-1958	+ 1.152 (.072) (.226)	
1897-1908	+ 2.554 (.387)	
1903-1913	+ 2.055 (.628)	
1908-1921	+ .168 (.364)*	
1913-1920	+ .065 (.49)*	
1920-1929	+ 1.724 (.229)	
1921-1933	+ 1.593 (.219)	
1929-1939	+ 1.595 (.237) (.356)	+ 1.471 (.234) (.322)
1933-1938	+ 1.254 (.138)	+ 1.176 (.336)
1938-1953	- .107 (.308)*	- .009 (.290)*
1939-1948	.077 (.362)*	+ .257 (.323)*
1948-1957	+ .669 (.249) (.781)≠	+ 1.526 (.462) (.587)
1929-1958	+ 1.575 (.443) (.563)	+ .687 (.239) (.750)≠

*Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

≠Coefficients are not significantly different from zero at the 5% level of signigicance using corrected standard error terms.

TABLE A-1--continued

$C = \alpha + VM_1$

Annual Figures	M_1
1920-1929	+ 3.532 (.440)
1921-1933	+ 4.083 (.367) (.506)
1929-1939	+ 1.624 (.543) (1.011)†
1933-1938	+ 1.836 (.135) (.227)
1938-1953	+ 1.589 (.139) (.436)
1939-1948	+ 1.225 (.135) (.239)
1948-1957	+ 1.710 (.096) (.138)
1929-1958	+ 3.555 (.267) (1.011)

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

† Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$C = \alpha + VM_1 + BP$

Annual Figures	M_1
1920-1929	+ 3.459 (.427)
1921-1933	+ 3.456 (.369)
1929-1939	+ 1.237 (.075)
1933-1938	+ 1.347 (.294)
1938-1953	- .537 (.255)*
1939-1948	- .168 (.293)*
1948-1957	+ .062 (.262)*
1929-1958	+ 2.565 (1.185) (1.895)$\not$

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

$\not$ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$Y = \alpha + V' M_1$

Annual Figures	M_1
1920-1929	+ 4.375 (.538)
1921-1933	+ 6.045 (.795) (1.731)
1929-1939	+ 3.403 (.835) (1.479)⌿
1933-1938	+ 2.645 (.203) (.489)
1938-1953	+ 1.735 (.129) (.311)
1939-1948	+ 1.366 (.126) (.174)
1948-1957	+ 1.942 (.091) (.116)
1929-1958	+ 3.924 (.281) (.882)

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

⌿ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

TABLE A-1--continued

$Y = \alpha + V' M_1 + BP$ Annual Figures	M_1
1920-1929	+ 4.330 (.566)
1921-1933	+ 4.263 (.541)
1929-1939	+ 1.809 (.132)
1933-1938	+ 1.653 (.155)
1938-1953	+ .011 (.358)*
1939-1948	+ .364 (.425)*
1948-1957	+ .481 (.271)*
1929-1958	+ 2.272 (1.148) (1.582)⌿

* Coefficients are not significantly different from zero at the 5% level of significance using uncorrected standard error terms.

⌿ Coefficients are not significantly different from zero at the 5% level of significance using corrected standard error terms.

APPENDIX B

SOURCES OF DATA USED

This appendix describes the sources of the data used for computation of the complete model presented in Chapter V. The three major sources will be abbreviated. These three sources are:

(1) United States Department of Commerce, Business Statistics, 16th Biennial Edition (United States Department of Commerce, Washington, D. C., 1967).

Abbreviation: Business Statistics

(2) ________, The National Income and Product Accounts of the United States, 1929-1965. Statistical Tables (United States Department of Commerce, Washington, D. C., 1966).

Abbreviation: National Income Accounts

(3) Board of Governors of the Federal Reserve System, Federal Reserve Bulletin (Board of Governors of the Federal Reserve System, Washington, D. C.).

Abbreviation: Federal Reserve Bulletin

Personal Consumption Expenditures: 1953-1965, quarterly seasonally adjusted data taken from Table 1.1, pp. 2-3, line 2 of National Income Accounts.

Gross Private Domestic Investment: 1953-1965, quarterly seasonally adjusted data taken from Table 1.1, pp. 2-3, line 6 of National Income Accounts.

Total Government Purchases of Goods and Services: 1953-1965, quarterly, seasonally adjusted data taken from Table 1.1, pp. 2-3, line 20 of National Income Accounts.

Exports: 1953-1965, quarterly, seasonally adjusted data taken from Table 1.1, pp. 2-3, line 18 of National Income Accounts.

Imports: 1953-1965, quarterly, seasonally adjusted data taken from Table 1.1, pp. 2-3, line 19 of National Income Accounts.

Disposable Personal Income: 1953-1965, quarterly, seasonally adjusted data taken from Table 2.1, pp. 34-35, line 22 of National Income Accounts.

Money Stock: 1953-1965, monthly data are taken from p. 100 and p. 240 of Business Statistics. Quarterly averages of the data were taken and then seasonally adjusted at the Federal Reserve Bank of Cleveland using the X-11 variant of the Census II Method, United States Department of Commerce, Bureau of the Census.

Short-Term Interest Rate: New issue rate on three-month Treasury bills, 1953-1965 monthly data from p. 90 and p. 237 of Business Statistics. Quarterly averages of the data were taken and then seasonally adjusted at the Federal Reserve Bank of Cleveland using the X-11 variant of the Census II Method, United States Department of Commerce, Bureau of the Census.

Long-Term Interest Rate: U. S. Treasury bonds, taxable, 1953-1965 monthly data taken from p. 105 and p. 242 of Business Statistics. Quarterly averages of the data were taken and then seasonally adjusted at the Federal Reserve Bank of Cleveland using the X-11 variant of the Census II Method, United States Department of Commerce, Bureau of the Census.

Rediscount Rate: 1953-1965 data are taken from p. A-9 in Federal Reserve Bulletin, January 1968. The rate taken for the quarter was that rate at the Federal Reserve Bank of New York which was prevalent for the greater part of the quarter.

Adjusted Monetary Base: Monthly data for 1953-1965 on the Source Base are supplied by the Federal Reserve Bank of St. Louis. Monthly figures for Discounts and Advances at the Federal Reserve are from various issues of the Federal Reserve Bulletin. These latter figures were then subtracted from the Source Base. Quarterly averages of the data were taken and then seasonally adjusted at the Federal Reserve Bank of Cleveland using the X-11 variant of the Census II Method, United States Department of Commerce, Bureau of the Census.