This is to certify that the

dissertation entitled

THE RELATIVE EFFECTIVENESS OF FISCAL
AND MONETARY POLICIES RECONSIDERED

presented by

Ehsan Ahmed

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Economics

James M. Johannes
Major professor

Date December 10, 1982

THE RELATIVE EFFECTIVENESS OF FISCAL AND MONETARY POLICIES RECONSIDERED

by

Ehsan Ahmed

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Economics

1983

ABSTRACT

THE RELATIVE EFFECTIVENESS OF FISCAL AND MONETARY POLICIES RECONSIDERED

by

Ehsan Ahmed

There has been a widespread disagreement in macroeconomic literature concerning the relative effectiveness of fiscal and monetary policies. A large part of the literature on this issue is theoretical, but unfortunately, theoretical models have not been able to resolve the dispute. The issue therefore, becomes empirical. The most well known empirical study on the relative effectiveness of fiscal and monetary policies was done by Andersen and Jordan in 1968. Andersen and Jordan conclude that the response of economic activity to monetary policy is larger, more predictable, and faster than fiscal policy. But Andersen and Jordan's conclusions have been widely criticized because of theoretical shortcomings, and because of statistical problems with empirical tests. The principal objections are: first, the use of high employment expenditures as appropriate fiscal policy variable, second, the use of Almon lag technique, third, the absence of relevant regressors,

fourth, the presence of heteroschedasticity and fifth, the simultaneous equation bias.

This dissertation uses the actual government spending as a fiscal policy variable, traditional monetary aggregates as monetary policy variables, and exports as third possible regressors. The primary focus is to investigate the severity of alleged simultaneous equation bias. This is done by testing the joint and individual exogeneity of all possible regressors. The primary conclusion is that the popular money supply measure M1B, actual government spending, and exports are all exogenous when the rate-of-change data are used. Therefore, it is plausible to use the ordinary least squares to estimate the reduced form. These estimates strongly support Carlson's (1970) original results, which implies that the sum of the coefficients for Δ log M1B is close to one. The addition of a third regressor or increasing the number of lags fails to reject the Carlson's specification. These conclusions are also highly compatible with Milton Friedman's monetary framework.

ACKNOWLEDGMENTS

I would like to express my gratitude to my dissertation advisor, Professor James M. Johannes for providing a detailed guidance during every aspect of this study. Without his help and guidance, this study would not have been completed. I am also indebted to Professor Robert H. Rasche for his helpful comments and insights during every stage of this dissertation.

I would also like to thank Professors W. Paul Strassmann and Christine Amsler for reviewing the dissertation and providing valuable suggestions. I am also indebted to my colleague Richard Cervin for his suggestions on the empirical parts of this dissertation.

I owe thanks to Ms. Terie Snyder for her skillful and expedient typing.

I would also like to thank my parents for their support during the years of my graduate studies. Last, but not the least, my deepest appreciation goes to my wife Dotte, for her support and encouragement throughout these years. Her professional skills in Economics and insights into the material contributed a great deal in improving the manuscript of this dissertation.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF TABLES (cont'd.)

CHAPTER ONE

INTRODUCTION

There has been widespread disagreement in macroeconomic literature concerning the relative effectiveness of fiscal and monetary policies. Since the great depression, Keynesian and Neo-Keynesians have believed that fiscal policy plays the major role in determining the level of income in industrialized and modern economies like the United States. They believe that government's fiscal tools can operate effectively in times of recession or high rates of inflation. Although the fiscal and monetary actions can be taken simultaneously, fiscal actions according to these groups, retain their effectiveness even if a supplementary monetary action is not taken by monetary authorities.

This view of the world has been seriously questioned by Milton Friedman and others who assert that the change in the stock of money is the primary determinant of changes in nominal GNP and therefore, should be given major attention in macroeconomic literature. This view became the point of departure of what is now referred to as the monetarist school of thought. This challenge to the

Keynesian view of the world has spawned a whole literature on exactly which policy is more effective. A large part of the literature is theoretical, but unfortunately, theoretical models have not been able to resolve the dispute. The issue, therefore, becomes empirical. As Friedman states, "One purpose of setting forth this framework is to document my belief that basic differences among economists are empirical, not theoretical....Much of the controversy that has swirled about the role of money in economic affairs reflects, in my opinion, different implicit or explicit answers to these empirical questions." [(1970), p. 237].

The importance of the empirical approach concerning the relative effectiveness of fiscal and monetary policies has been recognized in macroeconomic literature. Several economists have carried out empirical studies. [Andersen-Jordan (1968)], [Ben Friedman (1977)], [Carlson (1978)], [Barth and Bennet (1974)], [Deleeuw-Kalchbrenner (1969)], [Stephone-Grapentine (1979)], [Hafer (1981, 1982)], [Schadrack (1974)], [Keran (1969)], [Friedman-Meiselman (1963)].

The most well-known study was done by Andersen and Jordan (1968). Based on their empirical results, Andersen and Jordan conclude that "the response of economic activity to monetary actions compared with that of fiscal actions is (I) larger, (II) more predictable, and (III) faster." (p. 22). Given these results Andersen and Jordan rule out any considerable role of fiscal policy; however,

the Andersen and Jordan conclusions have been widely criticized because of the theoretical shortcomings of the model and because of statistical problems with the empirical tests. The principal objections are first, the use of high employment expenditures as the appropriate fiscal variable [Blinder-Solow (1974)], second, the use of the Almon Lag technique [Schmidt-Waud (1973)], third, the absence of relevant regressors [Hester (1964)], fourth, the presence of heteroschedasticity [Carlson (1978)], and fifth, simultaneous equation biases [Deleeuw-Kalchbrenner (1969)], [Hafer (1982)], [Feige-Pearce (1979)], [Geweke (1978)], [Granger (1969)], and [Sims (1972)].

Perhaps the most damaging of these criticisms, and the one given the least attention, is simultaneous equation bias. As Sims (1972) states, "It has long been known that money stock and current dollar measures of economic activity are positively correlated. There is further evidence that money or its rate of change tends to lead income in some sense. A body of macroeconomic theory, the quantity theory, explains these empirical observations reflecting a causal relation running from money to income. However, it is widely recognized that no degree of positive association between money and income can by itself prove that variation in money causes variation in income. Money might equally react passively and very reliably to fluctuations in income." (p. 540). Geweke (1978) develops tests of exogeneity in the "complete dynamic simultaneous model." According to

Geweke, "the specification of exogeneity is usually made a priori. If the specification is incorrect the otherwise identifying restrictions imposed on structural equations may not be sufficient to identify these equations, estimation procedures will be inconsistent, and the model cannot adequately portray the dynamics of the system it seeks to describe. It is therefore desirable to test the exogeneity specification rather than let it remain a mere assertion." [Geweke (1978), p. 163].

The primary purpose of this dissertation is to investigate the severity of the alleged simultaneous equation bias. This can be done by directly using an extension of the theorems of Sims (1972) to multivariate time series [Geweke (1978)]. However, to do this correctly, attention must also be given to the other four problems previously mentioned. The primary conclusion of this dissertation is that the popular money supply measure M1B, and the fiscal policy variable Act G (actual government spending) are both exogenous when the rate of change data is used. The third relevant right hand side variable, namely exports, also turns out to be exogenous. Therefore, it is plausible to use the OLSQ to estimate the Friedman type reduced form equation for nominal GNP. The estimated regressions thus, strongly implies that the sum of the coefficients for Δ log M1B is close to one. This is significant at the .05 level. The sum of the coefficients for Δ log Act-G is not significantly

different from zero. Moreover, the F tests do not reject the null hypotheses that the addition of the third right hand side variable, namely exports, and the addition of lags [(Schmidt-Waud (1973)] beyond the fourth quarter do not contribute to the explanation of variations in the rate of change in the nominal GNP.

There is some evidence that the money supply measure M1 (or M1B) does not turn out to be exogenous when the arithmetic first difference is used. The other two right hand side variables, namely actual G and exports are exogenous. When a change in nominal GNP (arithmetic first difference) is regressed against the change in M1B, actual G, and exports, using two stage least squares, the conclusions drawn by Andersen and Jordan do not hold. The fiscal multiplier turns out to be significantly different from zero over a period of nine quarters. However, it is extremely difficult to find the instrumental variables which are statistically exogenous. Therefore, growth rate data is preferred because it is used in the original Friedman and Andersen-Jordan work. (Andersen and Jordan, however, do not report the results in their 1968 paper.

The plan of this dissertation is the following:

Chapter Two:

Literature Review [Andersen-Jordan (1968)], [Blinder-Solow (1974)], [Barth-Bennet (1974)], [Stephens-Grapentine (1979)], [Friedman-Mieselman (1963)], [Schadrack (1974)], [Keran (1969)], [Hester (1964)], [Schmidt-Waud (1973)], [Friedman (1977)], [Carlson (1978)].

Chapter Three:

Reestimation of the modified and updated version of the Andersen-Jordan model. [Friedman (1977)], [Carlson (1978)].

Chapter Four:
Multivariate exogeneity tests for reduced forms using two right hand side variables. [Geweke (1978)], [Granger (1969)], [Johannes (1980)].

Chapter Five:
Multivariate exogeneity tests using three right hand side variables.

Chapter Six:
A specification and estimation of a more plausible reduced form.

Chapter Seven:
Conclusions and implications.

Appendix: Estimation of alternative reduced forms using alternative econometric techniques.

CHAPTER TWO

REVIEW OF THE LITERATURE

The most important study of the effectiveness of monetary and fiscal policies is that of Andersen and Jordan. It is of prime importance because it was the first such study and because subsequent research in this area uses Andersen and Jordan as the point of departure.

In their study, the relationship between total nominal spending (GNP), the money supply, and high employment federal expenditures or full employment surplus (HEG from now on) is tested. Andersen and Jordan's putative reduced form can be written in the following way:

$$\Delta Yt = \text{Constant} + \sum_{i=0}^{4} mi \Delta M_{t-i} + \sum_{i=0}^{4} ei \Delta HEG_{t-i} + U_t \qquad (2.1)$$

where Δ refers to the first differences of levels,

and where

Yt = Nominal GNP

Mt = Monetary base or monetary aggregate like M1B.

HEG = High Employment Government Sepnding (purchases).

U_t = Error term.

They use seasonally adjusted quarterly data for the U.S. economy from the first quarter of 1952 to the second quarter of 1968, and employ the Almon Lag procedure using a fourth degree polynomial with two end point constraints. Using these techniques, Andersen and Jordan test the following hypotheses:

1) Estimated coefficients for ΔHEG are larger and statistically more significant than the estimated coefficients for ΔM.
2) ΔHEG influences ΔY faster than ΔM.
3) The effect of ΔHEG is more predictable than ΔM.

Andersen and Jordan state that "The results of the tests were not consistent with any of these propositions. Consequently, either the commonly used measures of fiscal influence do not correctly indicate the degree and direction of such influence, or there was no measurable net fiscal influence on total spending in the test period....Rejection of three propositions under examination and acceptance of the alternatives offered carry important implications for the conduct of economic stabilization policy. All of these implications point to the advisability of greater reliance on monetary actions than on fiscal actions. Such a reliance would represent a marked departure from most present procedures." [Andersen-Jordan (1968), p. 22].

These controversial results were not widely accepted. Several studies have since emerged to check the

robustness of Andersen and Jordan's results to changes in data, time period, methodology and definitions of fiscal and monetary policy variables.

The first objection which was raised against Andersen and Jordan's study concerns the specification of the fiscal policy variable. Blinder and Solow (1974) raise objections against the use of HEG as a fiscal policy variable. There are various measures of fiscal policy. One can use an ordinary budget surplus, but this measure does not make a distinction between discretionary and automatic changes in the budget. Instead Blinder and Solow suggest that "the most obvious, and by now the most popular way to separate discretionary from automatic fiscal actions is to focus on the full employment budget." If the budget would be in surplus at full employment, fiscal policy is termed restrictive, if the budget would be in deficit, it is termed expansionary." (p. 14). But, HEG is subject to criticism. According to Blinder and Solow, "Like the ordinary surplus, the FES runs afoul of the balanced budget theorem; changes in tax receipts simply do not carry as much bang for the buck as changes in government purchases. Since the FES fails to weight tax receipts by the marginal propensity to consume, it is impossible to associate a given change in the FES with a specific change in income; it depends on how the change is apportioned between taxes and spending." (p. 17).

Another problem state Blinder and Solow, "arises

with the full employment surplus, whether weighted or unweighted, which did not afflict the ordinary budget surplus. Suppose the tax regulations (that is, the vector of parameters, π) are altered when the economy is very far below full employment. The revenue yield of this change at actual income levels may well be very different from the hypothetical revenue yield at full employment." (p. 17). This would make the HEG a meaningless measure during the periods of high unemployment rates.

Blinder and Solow suggest using the Weighted Standardized Surplus (WSS) instead. The WSS is derived by substracting the product of marginal propensity to consume (MPC) and marginal propensity to tax (tax parameter) from thd change in government expenditures. Blinder and Solow conclude that when ΔWSS is used instead of ΔHEG, the sum of the estimated coefficients for fiscal policy will change significantly. However, the WSS assumes that we know all the structural coefficients to begin with. If these coefficients are already known, there is no need to estimate the WSS.

Even if HEG is used as a fiscal variable, does it really have significant influence on nominal GNP? A study by Barth and Bennet (1974) indicates that HEG does not seem to have a significant relationship with nominal GNP. Barth and Bennet's study attempts to test two important hypotheses. First, a significant empirical relationship exists between ΔHEG and ΔY (nominal GNP). Second, causation runs from ΔY

to ΔHEG. Based on a sample from the first quarter of 1955 to the fourth quarter of 1961 for the U.S. economy, they reject both hypotheses. This implies that there is no significant statistical evidence that a variability in ΔY is caused by a variability in ΔHEG. The rejection of the second hypothesis implies that the variability in HEG does not seem to be caused by a movement in Y, i.e. HEG is exogenous with respect to Y. However, Barth and Bennet do not include a monetary variable in their regressions. Stephens and Grapentine (1979) point out that the inclusion of a monetary policy variable subjects the regression to error due to missing variables

Stephens and Grapentine's empirical investigation, which uses data from the second quarter of 1954 to the fourth quarter of 1975, fails to show any significant relationship between ΔHEG and ΔY. The evidence on causality from ΔY to ΔHEG is also inconclusive. In a more recent study, Hafer (1982) uses the Granger test to test the exogeneity of HEG and concludes that unindirectional causation from ΔY to ΔHEG cannot be rejected. In view of these studies, this dissertation contends that instead of ΔHEG or ΔWSS, one should use the ΔActG (actual government purchases) as the fiscal policy variable. The ActG is a better measure than HEG because it does not lose its usefulness during the periods of high unemployment. The ActG is easier to calculate and there is no need to introduce MPC or a tax parameter into the calculations.

The choice of an appropriate monetary aggregate has also been the subject of great interest in much of the literature. The well-known study of Friedman and Meiselman (1963) consider M2 as a superior monetary aggregate and say that M2 shows a significant influence on nominan GNP. The plausibility of M2 is also supported by Schadrack (1974), who estimates a relationship between six monetary aggregates and nominal GNP, concluding that M2 shows the most significant influence on nominal GNP. Hafer (1981), on the other hand, is concerned with the statistical exogeneity of measures like M1B and M2. He uses the Sims and Granger tests to estimate exogeneity and M2, and concludes that the exogeneity of these two monetary aggregates cannot be rejected. Moreover, he points out that the variability in nominal GNP is better explained by M1B.

An attempt is made by Keran (1969) to evaluate the plausibility of the money stock as a monetary aggregate. The money stock is defined as $M = mB$, where m is the money multiplier, and B the monetary base. The sources of the monetary base consists of various kinds of credit extended by the monetary authorities. The use of a monetary base is divided between currency holdings of the non-bank public and reserves of commercial banks. Keran tests the exogeneity of the monetary base by regressing it against nominal GNP. He concludes that the change in nominal GNP is not causing any significant variations in the monetary base. Therefore,

the monetary base is statistically exogenous and hence, can be used as an appropriate monetary aggregate.

However, Keran's conclusion is not shared by Deleeuw and Kalchbrenner (1969), who believe that the exogenous variable must be subject to control by policy makers, and must not respond to movements in endogenous variables. The monetary base will be exogenous only if the sum of its components namely, currency, borrowed reserves, and unborrowed reserves, is exogenous. Deleeuw and Kalchbrenner state, "few would disagree with the proposition that, at least as the discount window was been administered for the last fifteen years, member bank borrowings have responded strongly to current movements in business loan demand and the interest rate. The question of interest however, is not whether borrowings are endogenous, since presumably that would be a matter of common agreement, but rather whether there is a strong tendency for the movement in borrowing to be offset by movements in some other components of the base. If there is a tendency for endogenous responses in borrowing to be offset by movements in other components of the base, then the total base contains offsetting endogenous influences and preference should be the total base of the St. Louis regressions. If there is not such a tendency, then adjusting the base to remove borrowings in this latter case, might lead to statistical confusion between the effects of a high monetary base on the economy with the effects of a booming economy on borrowing and, hence on the base....Since it is

not hard to think of unborrowed reserves responding in either direction to a change in borrowing during the sample period of the regressions, it seems better to represent monetary policy by a variable which excludes member bank borrowing." (p. 8). A review of Deleeuw-Kalchbrenner's study indicates that the issue of an appropriate monetary aggregate is unresolved but appears to center on exogeneity.

Another major weakness of all these studies stems from the fact that other relevant variables may enter into the reduced form besides money supply and government spending. [Blinder and Solow (1974)]. Hester (1964), in his response to Friedman-Mieselman's CMC paper (1963) raises the issue of other relevant regressors in the reduced form. He introduces an autonomous spending variable (L) which is comprised of net private domestic investment, government purchases, and net exports. However, Hester's (L) has some problems: First, government spending (G) should be excluded in this work from (L), since effect of G alone is of direct interest. Second, imports (M) should also be excluded from (L) because they are known to be affected by changes in income. This implies that an alternative measure should be used which eliminates these problems. The alternative is (A) which is equal to private domestic investment, exports, and capital consumption allowance.

The third major weakness of the Andersen and Jordan model is attributed to another specification error. This

specification error occurs when a constrained Almon Lag is used. In order to estimate the relative effectiveness of fiscal and monetary policies, researchers have generally used the distributed lag scheme because the impact of any of these policy actions is expected to last beyond the current time period. From a statistical viewpoint, independent variables with lags are assumed to be stochastic and are not correlated with the disturbance term of the equation. Therefore, one can use ordinary least squares (OLSQ) to estimate their coefficients. A special case of the distributed lag scheme is the Almon lag technique. The Almon Lag expresses the coefficients of the right-hand side variable as a function of the length of the lag and fits appropriate curves to show the functional relationship between the two. The distributed lag regression can be written as follows:

$$Yt = \alpha_0 + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots. + \beta_n X_{t-n} + U_t \quad (2.2)$$

According to the Almon Lag procedure, the β_S can be approximated by the suitable degree of a polynomial. One can specify the degree of polynomial after the length of the lag is determined. The degree of the polynomial is generally the number of turning points. Moreover, in this technique, the choice of a lag depends on the discretion of the researcher. Anderson and Jordan use a fourth degree polynomial with two end point constraints. This supposedly

increases the efficiency of their estimates. But, in the words of Schmidt and Waud (1973), "imposing the restriction that the weights lie on a polynomial will lead to more efficient estimates and more powerful tests, if the restriction is true, and to biased and inconsistent estimates and invalid tests, if the restriction is false. This second possibility should be kept in mind, especially since the polynomial lag technique is often applied with little or no thought as to why it should be the case that the polynomial restriction is true." (p. 12). The length of the lag is another problem. If the length of the lag is over or under estimated, the regressors are subject to specification errors. Schmidt and Waud assert that unless there is an 'a priori' reason to believe that the lag is present, the polynomial distributed lag technique should be avoided. As Schmidt-Waud state, "the presence or absence of a lag is not a testable proposition when the Almon Lag technique is used." (It should perhaps be noted that this is a problem peculiar to the Almon Lag specification)....Actually, what is reflected in the preceding point is just the fact that the choice of the length of the lag is extremely touchy in the Almon specification. It is, of course, clear that under-stating the length of the lag (choosing n less than the true lag length) is a specification error which leads to biased and inconsistent estimates and invalid tests." (p. 13). Schmidt and Waud suggest that if the polynomial procedure is to be used, one should use a variable lag scheme for each

policy variable and different degrees of the polynomial should be used. Schmidt and Waud find that the minimum standard error is achieved when the length of the lags is extended to eight quarters. Although Schmidt and Waud criticize the Andersen and Jordan's use of Almon Lags, they do not attempt to evaluate the appropriateness and exogeneity of HEG or the monetary base.

The issue still remains that the use of a particular econometric estimation procedure is of secondary importance. The main issue is how to specify appropriate policy variables and test whether they are truely exogenous before they can be used on the right-hand side of the reduced form.

In addition to taking care of the specification errors and testing the exogeneity of right-hand side variables, there is also a need to check the robustness of Andersen and Jordan's model by increasing the sample size. Benjamin Friedman (1977) pays attention to this matter and increases the sample size up to the second quarter of 1976. However, he does not change the methodology. On the basis of this increased sample and constrained PDL technique, Friedman concludes that the sum of the coefficients for ΔHEG is significantly different from zero. This clearly contradicts the results of Andersen and Jordan. Since the methodology used here is the same as that used by Andersen and Jordan, and the specification of the reduced form remains the same, Friedman's estimates are also subject to specification errors.

Friedman's for, is also criticized by Carlson (1978), who asserts that a critical assumption in linear regression is that the variance of the error term remains constant during the estimation process. Friedman's data violate this assumption of homoschedasticity. Carlson suggests the use of a rate of change or growth in data, instead of an arithmatic first difference. This may help overcome the critical problem of heteroschedasticity.

In summary, the literature raises several problems with the Andersen and Jordan model, that must be addressed formally before the real value of Andersen and Jordan model, or a derivations like the Carlson model can be judged.

1) There is a specification error in terms of the derivation of the fiscal policy variable and methodology, in particular, the Almon lag technique. [Blinder-Solow (1974)], [Schmidt-Waud (1973)].
2) There is a possibility of missing variables, which subject the equation to specification errors. In a modified reduced form, a third exogenous variable A is recommended. A is comprised of nominal exports, private investment, and capital consumption allowance. An alternative version would be with (export) instead of (A). [Dernburg-McDougal (1963)], [Hester (1964)], [Hansen (1951)], [Samuelson (1961)].
3) The problem of heteroschedasticity can be taken

care of by using a rate of change instead of arithmetic first differences. [Carlson (1978)].

Some of the preceding issues have been addressed in the literature, but the issue of exogeneity and additional variables have not been adequately covered. This dissertation emphasizes the exogeneity issue and uses multivariate tests (Geweke 1978) to identify the appropriate fiscal policy variables and monetary aggregates. The exogeneity tests are also carried out on other possible right hand side variables. If the joint or individual exogeneity of any of the right-hand side variables is rejected, the use of OLSQ will produce inconsistent and biased estimates. In this case, one should use two-stage least squares or some other consistent estimator.

CHAPTER THREE

REESTIMATION OF MODIFIED VERSION OF ANDERSON-JORDAN'S MODEL

The last chapter briefly reviewed the study of Ben Friedman's (1977) work. Friedman reestimates the original Andersen and Jordan model by increasing the sample size up to the second quarter of 1976. His conclusion was that the sum of the estimated coefficients for ΔHEG is significantly different from zero. His work implies that Andersen and Jordan's estimates will be altered if the sample is updated. He produces these new estimates without any change in specification of fiscal or monetary policy variables, or estimation procedures. He does not test the statistical exogeneity of any of the right-hand side variables. Friedman's model was criticized by Carlson (1978) who points out that it violates the assumption of heteroschedasticity.

The contention in this dissertation is that heteroschedasticity is not the only problem with Friedman's model. Like Andersen and Jordan, Friedman's estimates are subject to specification errors due to the problem with fiscal variables [Blinder-Solow (1974)], and the use of Almon

Lags. [Schmidt-Waud (1973)]. The main argument is that the Andersen and Jordan model, the Friedman model, and Carlson's specifications may all suffer from simultaneous equation bias. Mere extension of the sample size to 1976 does not necessarily eliminate this bias. The fact is that if Friedman's model is updated (by extending the sample to the second quarter of 1980), one will actually get the original Andersen and Jordan result. This is shown in Tables 3.2 through Table 3.5. Table 3.7 produces estimates from an updated version of Carlson's model.

These new regressions follow the same lag scheme as Friedman and use constrained polynomial distributed lags. In the first regression (Table 3.3), ΔM1B is used as monetary policy and ΔHEG reflects the measure of fiscal policy. The data was obtained from the Survey of Current Business (1980)[1] and the FMP (Federal Reserve-MIT-University of Pennsylvania) model.

Seasonally adjusted quarterly data from the first quarter of 1959 through the second quarter of 1980 were used. The sum of the estimated coefficients for ΔM1B (Table 3.3, original Andersen-Jordan, and Friedman estimates are in Tables 3.1 and 3.2) is larger and more significant than Friedman's original model. The sum of the estimated coefficients for ΔHEG is only 0.86, which is significant only at the .10 level.

[1]Frank Deleeuw, Thomas M. Holloway, Darwing G. Johnson, Avid S. McClain, and Charles A. Whaite, "The High Employment Budget: New Estimates, 1955-1980," Survey of Current Business, November 1980, pp. 13-75.

TABLE 3.1

ORIGINAL ANDERSEN-JORDAN MODEL

Equation (1)		M	E
	0	1.54	.40
		(2.47)	(1.48)
	-1	1.56	.54
		(3.43)	(2.68)
	-2	1.44	-.03
		(3.18)	(.13)
	-3	1.29	-.74
		(2.00)	(2.85)
	Sum	5.83	.17
		(7.25	(.54)
	Constant	2.28	
		(2.76)	
	R^2	.56	
	s.e.	4.24	
	D.W.	1.54	

Equation (2)		M	E	R
	0	1.51	.36	.16
		(2.03)	(1.15)	(.53)
	-1	1.59	.53	-.01
		(2.85)	(2.15)	(.03)
	-2	1.47	-.05	-.03
		(2.64)	(.19)	(.10)
	-3	1.27	-.78	.11
		(1.82)	(2.82)	(.32)
	Sum	5.84	.07	.23
		(6.57)	(.13)	(.32)
	Constant	2.10		
		(1.88)		
	R^2	.58		
	s.e.	4.11		
	D.W.	1.80		

Reproduced from "Leonald C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis Review, February, 1978.

TABLE 3.2

BEN FRIEDMAN'S ESTIMATES

Period	ΔM1	ΔHEG
0	2.01 (3.10)	.30 (1.3)
-1	1.55 (3.6)	.10 (.6)
-2	.6 (1.1)	.09 (.4)
-3	.16 (.4)	.43 (2.5)
-4	.27 (.4)	.71 (2.8)
Sum	4.60 (4.60)	1.62 (4.1)
Constant = .65 (.03)	R^2 = .66 s.e. = 3.99 D.W. = 1.92	

Note: The numbers in parenthesis are t-values.

Reproduced from Benjamin Friedman, "Even the St. Louis Model Now Believes in Fiscal Policy," Journal of Money, Credit and Banking, May 1977.

TABLE 3.3

AN UPDATED VERSION OF FRIEDMAN'S MODEL

	ΔM1B	ΔHEG
0	3.24 (4.73	.37 (1.65)
-1	3.38 (6.93)	.16 (.93)
-2	1.87 (2.70)	-.01 (-.03)
-3	.03 (.06)	.08 (.41)
-4	-.95 (-1.17)	.26 (1.04)
Sum	7.55 (6.68)	.86 (1.64)

Sample 1959I - 1980II

Constant = -2.64
(-1.10)

$\bar{R}^2$ = .72

s.e. = 11.32

D.W. = 2.00

Note: The numbers in parenthesis are t-values.

TABLE 3.4

A MODIFIED AND UPDATED VERSION
OF BEN FRIEDMAN's MODEL

Period	ΔM1B	ΔActG
0	3.32 (4.83)	.21 (1.03)
-1	3.48 (7.21)	.97 (.64)
-2	1.96 (2.85)	.03 (.15)
-3	.09 (.20)	.12 (.69)
-4	-.92 (-1.13)	.24 (1.05)
Sum	7.93 (7.90)	.70 (1.55)

Sample = 1959I - 1980II

Constant = -2.81

$\bar{R}^2$ = .71

s.e. = 11.43

D.W. = 1.99

Note: The numbers in parenthesis are t-values.

TABLE 3.5

MODIFIED SPECIFICATION

	Δ M1B	Δ ActG	Δ A
0	1.24 (2.28)	.83 (5.31)	.96 (11.00)
-1	1.19 (2.54)	.23 (1.89)	.19 (2.47)
-2	.65 (1.37)	-.14 (-1.13)	-.23 (-3.36)
-3	.23 (.35)	.10 (.63)	.11 (1.31)
Sum	3.35 (3.00)	1.02 (3.73)	1.03 (5.10)

Sample 1951I - 1980II

Constant = 1.27 (.76) $\bar{R}^2$ = .90 D.W. = 1.91

A = Exports + Investment (private) + Capital Consumption Allowance

Note: The numbers in parenthesis are t-values.

TABLE 3.6

CARLSON'S ORIGINAL ESTIMATES

	M_1 (Δ log M_1)	HEG (Log HEG)
0	.40 (2.96)	.80 (2.26)
-1	.41 (5.26)	.06 (2.52)
-2	.25 (2.14)	.00 (.02)
-3	.06 (.71)	-.06 (-2.20)
-4	-.05 (-.37)	-.07 (-1.83)
Sum	1.06 (5.59)	.03 (.40)

Sample 1953I - 1976IV

Constant - 2.69 (3.23)

$\bar{R}^2$ = .40
s.e. = 3.75
D.W. = 1.75

Reproduced from Keith M. Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?", Federal Reserve Bank of St. Louis Review, February, 1978.

TABLE 3.7

AN UPDATED VERSION OF CARLSON'S MODEL

Period	Δ Log M1B	Δ Log HEG
0	.29 (2.17)	.11 (2.47)
-1	.37 (4.74)	.04 (1.34)
-2	.27 (2.75)	-.02 (-.51)
-3	.11 (1.44)	-.01 (-.25)
-4	-.04 (-.37)	.04 (.99)
Sum	1.00 (4.97)	.17 (1.88)

Sample 1959I - 1980II

Constant = .002 (1.34)

$\bar{R}^2$ = .37
D.W. = 2.03
s.e. = .01

These results are more compatible with Andersen and Jordan's model. In Table 3.4 the estimates do not seem to be any different from Andersen and Jordan when ΔActG replaces ΔHEG as a fiscal policy variable.

What happens to the same framework when we add a third variable to the right-hand side of the equation? The addition of the autonomous spending variable (A) to the right-hand side variables changes the estimates somewhat. (See Table 3.5). The question still remains whether the right-hand variables in all these alternative versions are truly exogenous. This question cannot be answered unless there is clear evidence that these regressions do not suffer from the simultaneous equation bias. The fiscal policy multiplier is significantly different from zero, but it is smaller than the multiplier produced by Friedman's model.

The next step was to estimate an updated version of Carlson's model, which uses rates of change instead of arithmetic first differences. The estimates are summarized in Table 3.7. They are very similar to the original Carlson estimates, which show a minor role of fiscal policy. Although Carlson's specification seems straightforward and more plausible, it is imperative that the exogeneity of all of the right hand side variables must be tested. If these variables are exogenous jointly and individually with respect to nominal GNP, it will be appropriate to use the OSLQ. If the regressors are not truly exogenous and the regressions are subject to simultaneous equation bias, it is not appropriate to use OLSQ or the PDL technique. This will lead to biased and inconsistent estimates.

The issue of exogeneity is considered in the next chapter, where multivariate tests for the joint and individual exogeneity are introduced.

CHAPTER FOUR

EXOGENEITY TESTS FOR REDUCED FORMS USING TWO RIGHT-HAND SIDE VARIABLES

The reduced form equations already examined in the literature show that independent variables must be correctly specified under the control of policy makers, and statistically exogenous. The controllability of a monetary aggregate or fiscal policy variable is essential from a policy point of view. For instance, if policy makers are making a change in monetary policy, the change is reflected through a monetary aggregate. If policy makers can effectively control this aggregate, it will be considered exogenous from the policy makers viewpoint. Even if an aggregate is controllable by policy makers, if it is not statistically exogenous, it will produce inconsistent and biased results. Statistical exogeneity means that the variable in question is independent of the disturbance term of the equation. The movement in the exogenous variable is not caused by current or past movements in the endogenous variable. For example, if a policy maker is attempting to change nominal GNP using monetary policy tools, the changes in nominal GNP should be a direct result of a change in monetary policy. This monetary aggregate should not in turn be affected by the changes in nominal GNP. If a policy variable is not exogenous in a statistical sense, we may not know whether we measured the influence of our policy on nominal GNP or whether nominal GNP's influenced the policy variable.

The exogeneity tests used in this chapter are based on Geweke's (1978) study. (Also see Granger 1969). He considers the "complete dynamic simultaneous equation model" (CDSEM). Consider the following relationship between variables Y and X:

$$\underset{(gxg)}{B(L)}\ \underset{(gx1)}{Y_t} + \underset{(gxk)}{\Gamma(L)}\ \underset{(kx1)}{X_t} = \underset{(gx1)}{e_i} \qquad (4.1)$$

The vector of the disturbance term is assumed to be serially uncorrelated. The operators B(L) and $\Gamma(L)$ are the polynomial matrices in the lag operator L. The operator L describes the relationship between k exogenous variables X_t, and g endogenous variables Y_t. The stability of operator B(L) requires that X_t exogenous variables and the error term Σ_i determine the endogenous variable Y_t. In a stable and complete model only current and past X_t's determine Y_t's. According to Geweke (1978) the X_t is "determined outside the CDSEM which in turn is a complete description of the interaction between X_t and Y_t, a proper specification of the determination of X_t will not include any values of Y_t."

(1978, p. 166). Granger (1969) has derived various useful tests based on this premise. [Also see Johannes (1980), Pierce-Hough (1975)].

For example, consider the following regression in which X_t is regressed on past X_t and past Y_t (Geweke 1978):

$$X_t = \sum_{s=1}^{\infty} F_s X_{t-s} + \sum_{s=1}^{\infty} G_s Y_{t-s} + e_t \qquad (4.2)$$

The variable X_t will be exogenous in this "complete dynamic simultaneous equation model" if $G_s = 0$ for all $s > 0$.

Some important aspects of the exogeneity test presented in Equation 4.2 are discussed in Dent and Geweke (1979) and Johannes (1980). First, the exogeneity of variable X_t can be hypothesized and subjected to testing. Second, the "complete dynamic simultaneous equation model with X_t will not exist if the implication of exogeneity is false." (Dent and Geweke 1979). Thirdly, it is not necessary to specify a model for X_t to test its exogeneity. Fourth, due to the presence of lags on the right-hand side, the test will be biased toward non-rejection of exogeneity, if there is a contemporaneous relationship between variables.

The exogeneity tests presented in this chapter rely on a reduced form frequently used by economists. Generally, economists use a reduced form with two right-hand side variables. The hypothesis tested in this chapter is that monetary aggregate and fiscal policy variables are all jointly exogenous with respect to the nominal GNP.

There are two relevant questions in this type of estimation (Johannes 1980). First, the choice of the lag for each variable and second, the choice of an appropriate statistic to test the null hypothesis that $G_s = 0$, (Equation 4.1) which implies that putative fiscal and monetary policy variables are in fact exogenous. Geweke (1978) favors longer lag periods for putative exogenous (X_t) variables but seems to feel that a shorter lag period is sufficient for endogenous variables (Y_t). Each variable in this study will have a contemporaneous value and eight quarterly lags.

As for test statistics, the Wald, the Likelihood Ratio Test, and the LaGrange multiplier are used to test the null hypothesis that $G_s = 0$ or $Y_{t-s} = 0$. All three test statistics are asymptotically distributed as Chi Square with 16 degrees of freedom (the degrees of freedom are the number of restrictions). If the computed value is greater than the critical value, the null hypothesis that the coefficients for Y_{t-i} are jointly zero will be rejected.[2]

---

[2]To test that M_{t-i} and $ActG_{t-i}$ are putative exogenous varuables you estimate two alternative versions of equation (4.3). The first version which estimates the unrestricted case has three uncorrelated regressions. The first regression regresses the contemporaneous value of ΔM (monetary aggregate) against the past value of ΔM, the past values of $\Delta ActG$ and the past values of ΔY (nominal GNP). The equation also includes a constant and a trend value which shows that the data possesses stationary characteristics. The second equation in the unrestricted case regresses $\Delta ActG$ (contemporaneous) against the past values of $\Delta ActG$, ΔM, and ΔY. It also includes both a constant and trend value.

An alternative version would omit the past values of ΔY_t from the right-hand side of the equation. The objective is to test the hypothesis that eight past coefficients of ΔY are jointly zero.

Tables 4.1 through 4.5 produce the results for the joint and individual exogeneity test. In each specification a different monetary aggregate is used with ActG. (The HEG was also used instead of ActG, but the tables do not contain these estimates.) The tables show the results both in terms of arithmetic first differences and rates of change ($\Delta \log X_i$).

Table 4.1 shows the the joint exogeneity of M1B and ActG is rejected on all grounds when the arithmetic first difference is used. The tests also indicate that the individual exogeneity of M1B is rejected, but the individual exogeneity of ActG is not rejected. However, the joint and individual exogeneity of M1B and ActG is not rejected when a Δ log form is used. Table 4.2 shows that in levels, the joint exogeneity of M2 and ActG is rejected on all grounds. This can be attributed to the individual rejection of ActG. The results show that the individual exogeneity of M2 is not rejected. The Δ log estimates do not reject the joint or individual exogeneity of M2 and ActG.

Table 4.3 has the exogeneity results for the monetary base and ActG. In the level estimates, the joint exogeneity of MB (base) and ActG, and individual MB is not rejected. The results using growth rate data do not reject the joint or individual exogeneity of MB and ActG. As to the individual exogeneity of UBR (unborrowed reserves), the results are not conclusive. The data with levels shows that the arithmetic first difference does not reject the individual exogeneity of UBR, but Δ log estimates do reject it.

TABLE 4.1

	Wald	Likelihood Ratio	LaGrange
Joint Exogeneity of M1B and ActG			
1. Levels	77.27 (Reject)	60.87 (Reject)	49.08 (Reject)
2. Logs	21.59 (Do Not Reject)	19.46 (Do Not Reject)	17.65 (Do Not Reject)
Individual Exogeneity of M1B		F-test	
1. Levels		5.43 (Reject)	
2. Logs		1.75 (Do Not Reject)	
Individual Exogeneity of ActG		F-test	
1. Levels		2.08 (Do Not Reject)	
2. Logs		0.30 (Do Not Reject)	

Critical value of $X^2_{.05,16}$ = 26.296

Critical value of $F_{8,51}$ = 2.14

TABLE 4.2

Joint Exogeneity of M2 and ActG	Wald	Likelihood Ratio	LaGrange
1. Levels	51.99 (Reject)	48.23 (Reject)	37.71 (Reject)
2. Logs	20.72 (Do Not Reject)	19.27 (Do Not Reject)	18.02 (Do Not Reject)

Individual Exogeneity of M2	F-Test
1. Levels	1.62 (Do Not Reject)
2. Logs	1.26 (Do Not Reject)

Individual Exogeneity of ActG	F-Test
1. Levels	3.39 (Reject)
2. Logs	2.07 (Do Not Reject)

Critical value of $X^2_{05,16}$ = 26.296

Critical value of $F_{8,51}$ = 2.14

TABLE 4.3

Joint Exogeneity of MB and ActG

	Wald	Likelihood Ratio	LaGrange
1. Levels	39.82 (Reject)	34.69 (Reject)	30.47 (Reject)
2. Logs	20.40 (Do Not Reject)	18.99 (Do Not Reject)	17.85 (Do Not Reject)

Individual Exogeneity of MB

	F-Test
1. Levels	1.13 (Do Not Reject)
2. Logs	1.26 (Do Not Reject)

Individual Exogeneity of ActG

	F-Test
1. Levels	2.73 (Reject)
2. Logs	0.64 (Do Not Reject)

Critical Value of $X^2_{05,16}$ = 26.296

Critical Value of $F_{8,51}$ = 2.14

TABLE 4.4

Joint Exogeneity of UBR and ActG

	Wald	Likelihood Ratio	LaGrange
1. Levels	57.16 (Reject)	47.11 (Reject)	40.48 (Reject)
2. Logs	35.98 (Do Not Reject)	32.16 (Do Not Reject)	28.88 (Do Not Reject)

Individual Exogeneity of UBR

	F-Test
1. Levels	1.35 (Do Not Reject)
2. Logs	2.18 (Reject)

Individual Exogeneity of ActG

	F-Test
1. Levels	4.21 (Reject)
2. Logs	1.31 (Do Not Reject)

Critical Value of $X^2_{.05,16}$ = 26.296

Critical Value of $F_{8,51}$ = 2.14

TABLE 4.5

EXOGENEITY OF REGRESSORS AT A GLANCE

Regressors	Arithmetic First Differences Joint	Arithmetic First Differences Individual	Rate of Change Joint	Rate of Change Individual
(1) M1B	Not Exogenous	Not Exogenous	Exogenous	Exogenous
(2) ActG		Exogenous		Exogenous
(1) M2	Not Exogenous	Exogenous	Exogenous	Exogenous
(2) ActG		Not Exogenous		Exogenous
(1) MB	Not Exogenous	Exogenous	Exogenous	Exogenous
(2) ActG		Not Exogenous		Exogenous
(1) UBR	Not Exogenous	Exogenous	Not Exogenous	Not Exogenous
(2) Act G		Not Exogenous		Exogenous

The foregoing results indicate that the evidence on the exogeneity of different monetary aggregates and ActG is not conclusive when data with levels is used. The individual exogeneity of M1B is rejected, but the estimates do not conclusively reject the exogeneity of other monetary aggregates. There is conclusive evidence that the joint or individual exogeneity of four monetary aggregates and ActG is not rejected (except Table 4.4) when growth rate data is used.

The results with growth rate data do not confirm the claims by Deleeuw and Kalchbrenner (1969) that UBR is statistically exogenous. The results with levels and growth rate data seem to support Keran's (1969) suggestion that MB is exogenous.

The tests performed in this chapter generally do not seem to reject the exogeneity of monetary aggregates like M2 or MB. It is not clear, however, whether this is due to the limitation of econometric techniques or to the problem of missing variables. Therefore, it will be worthwhile to specify alternative reduced forms which incorporate popular candidates for omitted variables to see if the results reported here are robust with respect to specification.

CHAPTER FIVE

EXOGENEITY TESTS FOR REDUCED FORMS USING THREE RIGHT-HAND SIDE VARIABLES

Chapter Four contained estimates from exogeneity tests performed on the reduced forms traditionally used in the literature. [Deleeuw-Kalchbrenner (1969), Keran (1969), Hafer (1982)]. These reduced forms usually regress nominal GNP against fiscal and monetary policy variables. But as pointed out in the last section of the previous chapter, there is a distinct possibility that these regressions might be subject to specification error due to missing variables. Although there are several variables that one can use to modify these traditional specifications, it seems appropriate to use A, an autonomous spending variable. (This variable was derived in Chapter Two.)

The new specification can be written in level as well as Δ log form:

$$\text{(Levels)} \quad \Delta Y_t = \alpha_0 + \sum_{i=0}^{9} \alpha_1 \Delta M_{t-i} + \sum_{i=0}^{9} \beta \; \Delta \, ActG_{t-i} + \sum_{i=0}^{9} \gamma \; \Delta A_{t-i} + e_i \qquad (5.1)$$

$$(\Delta \text{ Log Form}) \quad \Delta \text{ Log } Y_t = \alpha_0 + \sum_{i=0}^{9} \alpha_1 \Delta \text{ Log } M_{t-i} + \sum_{i=0}^{9} \beta \; \Delta \text{ Log ActG}_{t-i} + \sum_{i=0}^{9} \gamma \; \Delta \text{ Log } A_{t-i} + e_i \qquad (5.2)$$

Regression (5.1) regresses nominal GNP against a monetary aggregate (any of the M1B, M2, UBR, MB), a fiscal policy variable (ActG) and autonomous spending variable A(X + I + CCA) in arithmetic first difference. The regression (5.2) uses the data in Δ log form, that is, rate of change. The emphasis in this chapter is to test the joint and individual exogeneity of all three right-hand side variables with respect to nominal GNP. The results for the estimates are produced in Tables 5.1 through 5.5. The joint exogeneity of both regressions (levels and Δ log form) is rejected. This is probably due to the presence of A on the right-hand side. The individual exogeneity of A is rejected on all grounds, as one would expect in nominal terms. However, the individual exogenicty of ActG is not rejected in all cases. The individual exogeneity of M1B is rejected in both the level and Δ log forms. But the individual exogeneity of M2 and MB is rejected only in the level form. The individual exogeneity of UBR is not rejected both in the level and Δ log form. The summary of these conclusions is shown in Table 5.5.

The rejection of the exogeneity of variable A (nominal) may be due to the presence of private investment in its components. Since A is not exogenous, one cannot use OLSQ to estimate these equations. In order to take the search for a third exogenous variable a step further, I and CCA (investment and capital consumption allowance) are dropped from A. This leaves us with X(exports) only. Macroeconomic theory suggests that real exports are exogenous and free from the influence of nominal GNP. In the second part of this chapter, A is replaced by X and all right-hand side variables are tested for the joint and individual exogeneity again. The results are presented in Tables 5.6 through 5.10.

The joint and individual exogeneity of M1B, M2, MB, UBR, ActG and exports is not rejected when the Δ log form is used. The evidence is mixed however, when arithmetic first difference is used. The ActG turns out to be exogenous in all cases but the exogeneity of M1B is rejected. Exports turn out to be exogenous only when regressed with M1B and ActG. The individual exogeneity of M2, UBR and MB is not rejected. The summary of these results is produced in Table 5.10.

There is overwhelming evidence that all right hand side variables are exogenous (Table 5.10), when rate of change/form is used. Therefore, one can specify a more plausible reduced form in terms of rates of change. This reduced form can be written in the following manner:

TABLE 5.1

Joint Exogeneity of M1B, A and ActG

	Wald	Likelihood Ratio	LaGrange
1. Levels	450.77 (Reject)	204.82 (Reject)	118.53 (Reject)
2. Logs	327.75 (Reject)	158.38 (Reject)	94.39 (Reject)

Individual Exogeneity of M1B

	F-Test
1. Levels	8.79 (Reject)
2. Logs	3.94 (Reject)

Individual Exogeneity of A

	F-Test
1. Levels	21.58 (Reject)
2. Logs	8.84 (Reject)

Individual ActG

	F-Test
1. Levels	0.70 (Do Not Reject)
2. Logs	1.16 (Do Not Reject)

Critical $X^2_{.05,24} = 36.415$

Critical $F_{.05\,(8,43)} = 2.17$

TABLE 5.2

Joint Exogeneity of M2, A and ActG

	Wald	Likelihood Ratio	LaGrange
1. Levels	432.63 (Reject)	199.23 (Reject)	118.43 (Reject)
2. Logs	265.72 (Reject)	137.79 (Reject)	85.51 (Reject)

Individual Exogeneity of M2

	F-Test
1. Levels	2.63 (Reject)
2. Logs	1.09 (Do Not Reject)

Individual Exogeneity of A

	F-Test
1. Levels	13.55 (Reject)
2. Logs	5.70 (Reject)

Individual Exogeneity of ActG

	F-Test
1. Levels	0.50 (Do Not Reject)
2. Logs	0.85 (Do Not Reject)

Critical $X^2_{.05,24}$ = 36.415

Critical $F_{.05\,(8,43)}$ = 2.17

TABLE 5.3

Joint Exogeneity of MB, A and ActG

	Wald	Likelihood Ratio	LaGrange
1. Levels	328.43 (Reject)	164.22 (Reject)	99.51 (Reject)
2. Logs	269.67 (Reject)	132.94 (Reject)	82.72 (Reject)

Individual Exogeneity of MB

	F-Test
1. Levels	3.29 (Reject)
2. Logs	1.33 (Do Not Reject)

Individual Exogeneity of A

	F-Test
1. Levels	29.97 (Reject)
2. Logs	15.54 (Reject)

Individual Exogeneity of ActG

	F-Test
1. Levels	1.03 (Do Not Reject)
2. Logs	0.98 (Do Not Reject)

Critical $X^2_{.05,24} = 36.415$

Critical $F_{.05\,(8,43)} = 2.17$

TABLE 5.4

Joint Exogeneity of UBR, A and ActG

	Wald	Likelihood Ratio	LaGrange
1. Levels	446.88 (Reject)	213.48 (Reject)	97.89 (Reject)
2. Logs	289.92 (Reject)	134.41 (Reject)	77.28 (Reject)

Individual Exogeneity of UBR

	F-Test
1. Levels	.996 (Do Not Reject)
2. Logs	.774 (Do Not Reject)

Individual Exogeneity of A

	F-Test
1. Levels	21.08 (Reject)
2. Logs	10.78 (Reject)

Individual Exogeneity of ActG

	F-Test
1. Levels	1.46 (Do Not Reject)
2. Logs	0.92 (Do Not Reject)

Critical $X^2_{.05,24} = 36.415$

Critical $F_{.05\,(8,43)} = 2.17$

TABLE 5.5

EXOGENEITY OF REGRESSORS AT A GLANCE

Regressors	Arithmetic First Differences (Levels)		Rate of Change (Δ Log)	
	Joint	Individual	Joint	Individual
1. M1B		Not Exogenous		Not Exogenous
2. ActG	Not Exogenous	Exogenous	Not Exogenous	Exogenous
3. A		Not Exogenous		Not Exogenous
1. M2		Not Exogenous		Exogenous
2. ActG	Not Exogenous	Exogenous	Not Exogenous	Exogenous
3. A		Not Exogenous		Not Exogenous
1. MB		Not Exogenous		Exogenous
2. ActG	Not Exogenous	Exogenous	Not Exogenous	Exogenous
3. A		Not Exogenous		Not Exogenous
1. UBR		Exogenous		Exogenous
2. ActG	Not Exogenous	Exogenous	Not Exogenous	Exogenous
3. A		Not Exogenous		Not Exogenous

TABLE 5.6

INDIVIDUAL EXOGENEITY OF M1B, ACTG AND X

	F-Test
Individual Exogeneity of M1B	
1. Levels	2.86 (Reject)
2. Logs	1.84 (Do Not Reject)
Individual Exogeneity of ActG	
1. Levels	0.22 (Do Not Reject)
2. Logs	0.29 (Do Not Reject)
Individual Exogeneity of X	
1. Levels	2.09 (Do Not Reject)
2. Logs	2.15 (Do Not Reject)

Critical $F_{.05\,(8,40)} = 2.18$

TABLE 5.7

INDIVIDUAL EXOGENEITY OF M2, ACTG AND X

	F-Test
Individual Exogeneity of M2	
1. Levels	1.86 (Reject)
2. Logs	1.07 (Reject)
Individual Exogeneity of ActG	
1. Levels	.72 (Do Not Reject)
2. Logs	.46 (Do Not Reject)
Individual Exogeneity of X	
1. Levels	3.58 (Reject)
2. Logs	1.75 (Do Not Reject)

Critical $F_{.05\,(8,40)} = 2.18$

TABLE 5.8

INDIVIDUAL EXOGENEITY OF BASE, ACTG AND X

Individual Exogeneity of Base

	F-Test
1. Levels	1.09 (Do Not Reject)
2. Logs	1.10 (Do Not Reject)

Individual Exogeneity of AG

	F-Test
1. Levels	.50 (Do Not Reject)
2. Logs	.38 (Do Not Reject)

Individual Exogeneity of X

	F-Test
1. Levels	2.74 (Reject)
2. Logs	1.71 (Do Not Reject)

Critical $F_{.05\,(8,40)} = 2.18$

TABLE 5.9

INDIVIDUAL EXOGENEITY OF UBR, ACTG AND X

	F-Test
Individual Exogeneity of UBR	
1. Levels	.96 (Do Not Reject)
2. Logs	1.45 (Do Not Reject)
Individual Exogeneity of AG	
1. Levels	1.29 (Do Not Reject)
2. Logs	1.02 (Do Not Reject)
Individual Exogeneity of X	
1. Levels	3.5 (Reject)
2. Logs	1.65 (Do Not Reject)

Critical $F_{.05\,(8,40)} = 2.18$

TABLE 5.10

EXOGENEITY OF REGRESSORS AT A GLANCE

Regressors	Arithmetic First Difference (Levels)	Rate of Change (Δ Log)
1. M1B	Not Exogenous	Exogenous
2. ActG	Exogenous	Exogenous
3. X	Exogenous	Exogenous
1. M2	Exogenous	Exogenous
2. ActG	Exogenous	Exogenous
3. X	Not Exogenous	Exogenous
1. MB	Exogenous	Exogenous
2. ActG	Exogenous	Exogenous
3. X	Not Exogenous	Exogenous
1. UBR	Exogenous	Exogenous
2. ActG	Exogenous	Exogenous
3. X	Not Exogenous	Exogenous

$$\Delta \log Y_t = \alpha + \beta \sum_{t=0}^{9} \Delta \log M1B_{t-i} + \gamma \sum_{t=0}^{9} \Delta \log \text{Act-G}_{t-i} + \lambda \sum_{t=0}^{9} \Delta \log X_{t-i} + e_i \quad (5.4)$$

The right hand side variables in equation 5.4 are exogenous (see Table 5.6) and the rate of change form also fulfills the criterion of homoschedasticity (Carlson 1978). This equation can be estimated by using the OLSQ method. The equation is estimated in the next chapter.

CHAPTER SIX

SPECIFICATION AND ESTIMATION OF A MORE PLAUSIBLE REDUCED FORM EQUATION

The exogeneity tests performed in Chapter Four and Five help us derive a modified version of a traditionally used reduced form. This reduced form was shown in equation 5.4. The regression 5.4 can be written in matrix notation:

$$\Delta \text{ Log } Y = \Delta \text{ Log } M1B\ \beta + \Delta \text{ Log } ActG\ \gamma + \Delta \text{ Log } X \lambda + e \qquad (6.1)$$

As the specification 6.1 shows, the variables are measured in terms of rate-of-change instead of arithmetic first difference. This specification is preferred because (1) it is defendable on theoretical as well as empirical grounds. Milton Friedman (1970) supports the form with the rate-of-change instead of levels. As Friedman (1970) states, "the conclusion is that substantial changes in prices or nominal income are almost invariably the result of changes in the nominal supply of money." (p. 3). In the same paper Friedman derives a relationship between nominal GNP and the nominal money supply, which can be written in the following way:

$$\frac{d \log Y}{dt} = \frac{d \log M}{dt} \tag{6.2}$$

As Friedman states "this equation says that a change in money supply is reflected immediately and proportionally in nominal GNP.

Andersen and Jordan originally carried out tests with the rate-of-change instead of first difference. However their results were not presented in their 1968 paper. Carlson criticizes the Andersen-Jordan model and states that the "estimation of that equation in arithmetic first difference form no longer appears to be acceptable because there is an evidence of a nonconstant errors variance. Hence, it is difficult to assess the statistical reliability of any conclusions about the impact of monetary and fiscal actions based on estimates withthat form of equation." (p. 18). But as pointed out in Chapter Two and Three of this dissertation, the question of utmost importance is to test whether right hand side variables are truely exogenous.

When comparing Carlson's (Table 3.6) with this regression, one may note that:

(1) The tests do not reject the exogeneity of all three right hand side variable (Δ Log M1B, Δ Log ActG and Δ Log X) in equation 5.4.

(2) The exports are included on the right hand side to overcome the specification error due to missing variables.

(3) The variable for fiscal policy is ActG, instead of HEG.

(4) This regression increases the number of lags as recommended by Schmidt and Waud (1973). There is a contemporaneous time period as well as eight quarterly lags. Schmidt and Waud achieve a minimum standard error criterion by using the time period which covers eight quarters.

(5) The OLSQ method is used instead of the constrained PDL.

(6) The sample as shown in the tables is updated and covers a time period from the first quarter of 1959 through the third quarter of 1979.

With thse modifications, the estimates for equation 5.4 are presented in Table 6.1. As results show, the estimated coefficients for monetary as well as fiscal policy are not considerably different from the original Carlson's estimates. The sum of the coefficients for Δ Log M1B is 0.87, which is very close to Carlson's estimates.

The sum of the coefficients for Δ Log ActG is amazingly similar of Carlson's estimates. Both have the sum equal to 0.03, which is not significant statistically. The replacement HEG with ActG does not alter Carlson's estimates considerably. This raises an interesting question. Can we reject Carlson's specification? That is, given equation 6.1 can we reject the following hypotheses:

(1) The rate-of-change in export does not explain any rate-of-change in the nominal GNP. In statistical terms, this is to test the null hypotheses Ho that $\lambda_1 = 0$ where i = 0...., 8.

(2) Increasing the number of lags from four to eight does not explain any variability in the rate-of-change of nominal GNP. This is to test the null hypothesis that $\beta_i = 0$ where i = 5 ...., 8

$\gamma_i = 0$ where i = 5 ...., 8

$\lambda_i = 0$ where i = 5 ...., 8

3. To test whether the addition of a third right hand variable, increasing the number of lags, and removing the polynomial constraints, contributes to the variability or rate-of-change in the nominal GNP. This can be accomplished by testing hypothesis 1 and 2 together in the unconstrained regression.

The F tests[3] do not seem to reject any of these hypotheses. The results for alternative regressions

---

[3] It can be accomplished by running the following three regressions:

(i) $$\Delta \log Y_t = \alpha + \beta \sum_{i=0}^{9} \Delta \log M1B_{t-i} + \gamma \sum_{i=0}^{9} \Delta \log ActG_{t-i} + U_i$$

(ii) $$\Delta \log Y_t = \alpha + \beta \sum_{i=0}^{5} \Delta \log M1B_{t-i} + \gamma \sum_{i=0}^{5} \Delta \log ActG_{t-i} + \lambda \sum_{i=0}^{9} \Delta \log X_{t-i} + U_i$$

(iii) $$\Delta \log Y_t = \alpha + \beta \sum_{i=0}^{5} \Delta \log M1B_{t-i} + \gamma \sum_{i=0}^{5} \Delta \log ActG_{t-i} + U_i$$

are produced in Tables 6.2, 6.3 and 6.4. This implies that first, the addition of a third right hand side variable does not seem to contribute to the rate-of-change of nominal GNP. Second, increasing the number of quarterly lags, does not seem to accomplish any significant variability in the nominal GNP, and these results do not support the Schmidt-Waud (1973) claims.

$$F = \left(\frac{R^2_{\text{Long Regression}} - R^2_{\text{Short Regression}}}{1 - R^2_{\text{Long Regression}}} \right)$$

$$\left(\frac{\text{Total Number of Coefficients in the Long Regression}}{\text{Number of Coefficients in the Long Regression}} - \frac{\text{Number of Coefficients in the Long Regression}}{\text{Number of Coefficients in the Short Regression}} \right)$$

The long regression in this case is 5.4.

The short regressions are i, ii, and iii. Hypothesis (1) is rejected if the tabulated value is smaller than the critical value $F^{.05}_{(9,49)} = 2.80$. The tabulated value in this case is 1.8. Therefore the hypothesis that $\lambda_i = 0$ where i = 0 ...., 8 is not rejected.

Hypothesis (2) that $_i = 0$ where i = 5 ...., 8

$_i = 0$ where i = 5 ...., 8

$_i = 0$ where i = 5 ...., 8

is not rejected because tabulated value (0.78) is smaller than the critical value of $F^{.05}_{(13.46)} = 2.32$.

Hypothesis (3) that (a) $_i = 0$ where i = 0 ...., 8

(b) $_i = 0$ where i = 5 ...., 8

(c) $_i = 0$ where i = 5 ...., 8

(d) The lagged do not lie on the polynomial

is not rejected because tabulated value is 1.90 which is smaller than critical value of $F^{.05}_{(17,47)} = 2.09$

that longer lag scheme will achieve the minimum standard error. Third, the validity of Carlson's (1978) original estimates hold. This implies that the elasticity of nominal GNP with respect to a narrowly defined money supply is close to one. Moreover, the sum of the coefficients for log ActG is not significantly different from zero.

An overall look at the estimates in Tables 6.1 through 6.4 and the F tests show that the validity of Carlson's (1978) original estimates strongly holds and the specification with the rate of change instead of an arithmetic first difference is more preferable. The right hand side variables in this form are exogenous and one is not subject to simultaneous equation bias.

It should also be noted that in the alternative specification presented in 6.3, where Δ log X_i is dropped, the sum of the coefficients for Δ log M1B is very close to one. The sum of the estimated coefficients is very close to one during the first five quarters. This is in accordance with the F-test results that the increase in number of lags or addition of the third variable on the right hand side do not contribute to the variability of the nominal GNP and the validity of Carlson's estimates hold.

TABLE 6.1

OLSQ RATE OF CHANGE

	Δ ln M1B	Δ lnG(Act)	Δ lnX
0	.46 (2.29)	.003 (.07)	.04 (1.78)
-1	.27 (1.15)	.17 (3.35)	.01 (.39)
-2	.37 (1.56)	-.10 (-2.15)	-.03 (-1.19)
-3	.18 (.74)	.02 (.41)	-.01 (-.27)
-4	-.43 (-1.88)	-.02 (-.40)	-.04 (-1.77)
-5	.15 (.62)	-.09 (-1.74)	-.001 (-.07)
-6	.07 (.30)	.04 (.92)	.03 (1.43)
-7	-.38 (-1.62)	.01 (.27)	.04 (1.68)
-8	.19 (.98)	-.01 (-.10)	-.03 (-1.40)
Sum	.87 (2.64)	.03 (-.26)	.01 (0.16)

Sample 1959I - 1979III

Adjusted $\bar{R}^2$ = .41

Constant = .008
(2.46)

D.W. = 1.73

TABLE 6.2

THE UPDATED ESTIMATES FOR CARLSON'S MODEL USING ACTUAL G INSTEAD OF HEG

	OLSQ	
Period	Δ Log M1B	Δ Log ActG
0	0.32 (2.59)	.06 (1.52)
-1	0.40 (5.19)	.03 (.87)
-2	0.30 (2.90)	-.004 (-.12)
-3	.11 (1.50)	.008 (.27)
-4	-.04 (-.34)	-.03 (.97)
Sum	1.09 (6.30)	.13 (1.44)

SMPL = 1959I - 1979III   Constant = .003 (1.37)

R^2 = .39

D.W. = 1.99

TABLE 6.3

THE OLSQ ESTIMATES AFTER DROPPING Log X_i

Period	Δ Log M1B	Δ Log Act G
0	.46 (2.28)	.02 (.49)
1	.44 (1.94)	.12 (2.66)
2	.13 (.58)	-.11 (-2.30)
3	.34 (1.51)	.04 (.96)
4	-.39 (-1.73)	-.007 (-.14)
5	.22 (.98)	-.06 (-1.28)
6	-.29 (-1.34)	.07 (1.66)
7	-.12 (-.57)	.01 (.29)
8	0.10 (0.60)	-.04 (-.84)
Sum	0.89 (2.97)	0.04 (0.15)

SMPL = 1959I - 1979III

$\bar{R}^2$ = .36

D.W. = 1.79

Constant = .007
(2.32)

TABLE 6.4

THE OLSQ ESTIMATES WITH FOUR QUARTERLY LAGS

Period	Δ Log M1B	Δ Log ActG	Δ Log X
0	.51 (2.94)	.02 (.54)	.03 (1.42)
1	.20 (.96)	.14 (3.05)	.01 (0.83)
2	.34 (1.52)	-.06 (-1.52)	-.02 (-1.18)
3	.30 (1.34)	.06 (1.45)	.004 (-.24)
4	-.33 (-1.75)	.007 (0.16)	-.02 (-1.28)
Sum	1.02 (2.55)	0.17 (.22)	0.02 (0.5)

SMPL = 1959I - 1979III

$\bar{R}^2$ = .47

D.W. = 1.82

Constant = .003
(1.59)

A Concluding Remark

An alternative regression for (5.4) was run by using arithmetic first differences. This regression applies 2SLSQ because ΔM1B is not exogenous. The results are produced in appendix A. The difficulty in estimating 2SLSQ is that it is hard to find truly exogenous instrumental variables.

The regressions were also run by using M2, UBR and MB with A(X + I + CCA) and X. The regressions with A use 2SLSQ because A is not exogenous in any of the specifications. The results are presented in appendix B. The rest are run by using the OLSQ. The estimates from these regressions are presented in appendix C.

CHAPTER SEVEN

CONCLUSIONS AND IMPLICATIONS

In chapters four, five and six, an attempt is made to modify, respecify and update the Andersen-Jordan model, in view of the objections raised by various studies reviewed in Chapter Two. The right hand side variables in alternative reduced forms are then tested for individual and joint exogeneity by the F, Wald, Likelihood ratio and LaGrange tests. These tests help to specify an appropriate equation presented in 5.4 and 6.1. Since all the right hand side variables in this equation are exogenous, this form with the rate of change can be estimated by using OLSQ. The estimated coefficients for this specification are not significantly different than Carlson's (1978) estimates. The elasticity of the nominal GNP with respect to the money supply (assuming other variables constant) is very close to one. Some other conclusions follow:

First, this dissertation contends that the policy variables must be appropriately specified. The preferred specification for fiscal policy is ActG and for monetary policy, M1B.

Second, after these variables are appropriately specified they must be subjected to standard exogeneity tests. It turns out that ActG passes these tests and its exogeneity is not rejected in most specifications. Therefore, it was chosen as a fiscal policy measure. However, the exogeneity of M1B is rejected in all cases when the arithmetic first difference is used. The studies which use ΔM1B as a monetary aggregate and estimate the reduced form with OLSQ are clearly subject to the problem of simultaneous equation bias. If one is using ΔM1B, one must resort to the 2SLSQ or some other consistent estimator. But, it should be noted that the choice of an appropriate instrumental variable for money supply will be a difficult task. Although the 2SLSQ tests were carried out with arithmetic first differences, (appendix A), this dissertation contends that the rate of change is more straight-forward and plausible. Third, the tests in Chapters Four and Five do not clearly reject the exogeneity of other monetary aggregates like M2, UBR, and MB. Fourth, a comparison with other regressions which use M2, UBR or MB as monetary aggregates whows that the variation in the nominal GNP is explained better by M1B (see Appendices B and C). The estimates for M2 and UBR show that they have a rather insignificant influence on the nominal GNP. The ActG, when regressed with these aggregates individually, show better performance. However, the OLSQ estimates which regresses the nominal GNP against ΔMB, ΔActG and ΔX shows that both ΔMB and ΔActG produce significant results. The poor performance by M2 and UBR seems to contradict Friedman's and Deleeuw-Kalchbrenner's claims that they are superior monetary aggregates. Fifth, in order to deal with the specification error due to missing variables, this study introduced the third right hand side variable, A. A refers to the autonomous spending variable which is comprised of exports, net domestic investment and capital consumption allowance. But, the tests reject the exogeneity of A in all cases. One would expect this because A is in nominal terms. This is also possible due to the presence of private investment in its components. The variation in interest rate causes a variation in A. The exogeneity tests, however, do not reject the exogeneity of X in most cases. Sixth, the F tests, however do not reject the hypotheses that the addition of exports on the right side and increasing the number of lags does not contribute to the variation of nominal GNP. This is strongly in conformity with Carlson's results. The overall look at the estimates shows that Friedman's monetary framework holds. This implies that in the short run, the variability in money supply is fastly transmitted as a change in the nominal GNP. The rate of change results point to the relative impotency of fiscal policy. This does not mean that fiscal policy does not matter. What it means is that fiscal policy unaccompanied by monetary policy will have a relatively insignificant effect on nominal economic activity.

APPENDICES

APPENDIX A

The exogeneity tests performed in Chapter Four also help us derive another version of the traditionally used reduced form. This reduced form can be written in the following way:

$$\Delta Y_t = + \sum_{i=0}^{9} M1B_{t-i} + \sum_{i=0}^{9} ActG_{t-i} + \sum_{i=0}^{9} X_{t-i} + U_i \qquad (A.1)$$

The question of utmost importance is whether we can use OLSQ to estimate this regression. The answer is no. The reason is obvious! The exogeneity tests in Table 5.6 show that ΔM1B is not exogenous, though ActG and X are both exogenous.

The estimation technique appropriate in this case is 2SLSQ (two stage least square or instrumental variables method).

The rejection of the exogeneity of ΔM1B may imply that it is likely to be correlated with the stochastic disturbance term of the equation. In order to overcome this problem, one can find a proxy for ΔM1B, which is closely associated with M1B, but not with the disturbance term. Such a proxy is called an instrumental variable. [Gujarati (1978), Kmenta (1971)].

In order to find an appropriate instrumental variable for M1B, one needs to look at the U.S. monetary history. Smith (1972) suggests that, "the Federal Reserve focus on the treasury bill rate as its basic guide for monetary policy. There are several advantages in this approach. First, the Federal Reserve can without any basic change in its operating procedures, control the treasury bill rate with cirtually any degree of accuracy it desires. Secondly, there are many occasions on which the bill rate must be a focus of attention anyway, because it is the key short term rate affecting international flows. Thirdly, the bill rate is closely related to market interest rates on those forms of short and intermediate debt that compete with fixed-value redeemable claims and are therefore of critical importance for the availability of mortgage funds. Fourthly, there is considerable evidence that the term rates that are important in determining the cost of capital to business firms, state and local governments, and home buyers." (p. 467).

A look at the U.S. monetary data indicates that for a period prior to the fall of 1966, short term treasury bill rate (TBR) would be a good proxy. Since the fall of 1966 (after the financial crunch), the Fed seems to have focused its attention on the movements of Federal funds rate FFR. [Macrowitz (1981)], [Simpson (1979)], [Willis (1970)]. One should note that the Fed controls money supply by influencing the Federal funds rate (FFR) which reflects the cost of interbank borrowing. [Macrowitz (1981)]. Whenever there is a fluctuation in the supply of unborrowed reserves, the federal funds rate changes. If the supply of unborrowed reserves goes down, the federal funds rate immediately goes up. On the other hand, when the supply of unborrowed reserves goes up, the federal funds rate goes down. The changes in federal funds rate affect the interest rate which commercial banks charge on their loans. Since the fall of 1966, the Fed has focused on the federal funds rate as the major operating target of monetary policy. [Macrowitz (1981)]. Whenever money growth went above the desired level, the Fed raised the Federal Funds rate. However, the inflation in the 1970's and the Fed's overshooting of the money supply target raised serious questions about the usefulness of the federal funds rate. Therefore, since October 1979, the Fed seems to have changed its attention from the Federal funds rate to the unborrowed reserves themselves.

In view of this historical behavior, it is plausible to use the short-term treasury bills rate (TBR) from 1959I to 1966II and the federal funds rate from 1956III to 1979II as qualitative (dummy) instrumental variables. Once these proxies for M1B are available, one can use the 2SLSQ method to estimate this equation. As Kelejian and Oates (1974) state, "it is a two-step estimation procedure. In the first step, we 'purge' or eliminate from the independent variables, that part which is correlated with the disturbance term; this involves generating a revised set of values for the suspect independent variables. These 'revised' values are no longer correlated with the disturbance term so that the second step is simply to estimate the parameters with our standard OLSQ technique." (p. 228). The revised value of the suspect independent variable is estimated by regressing it against instrumental variables. In our case, M1B will be regressed against FFR, TBR and other predetermined variables like X and G. Kelejian and Oates (1974) state that "under certain conditions, we can simply treat all lagged endogenous variables as predetermined variables." (p. 237). This would allow us to treat the lagged values of M1B as predetermined.

Once the revised value for M1B is estimated, the new value of $\hat{M}$1B replaces the original M1B, and in the second stage one can estimate equation A.1 by using the standard OLSQ method.

The 2SLSQ estimates are consistent and are expected to converge to their true values as the sample size increases. [Gujarati (1978)].

The 2SLSQ estimates are produced in Table A.1. As the table indicates the sum of the coefficients (current and eight quarterly lags) for ΔM1B is 4.03, which is significant at the .01 level. The sum of the coefficients for ΔActG is 2.52, which is also significant at the .01 level. The sum of the coefficients for ΔX is positive but not statistically significant. Compare these results with Anderson and Jordan: In table A.1,

1. Δ ActG replaces ΔHEG.
2. ΔX is included as a third right-hand-side variable.
3. The sample period runs from 1959I to 1979III.
4. The time period covers eight quarterly lags instead of four.
5. The instrumental variable method is used instead of the constrained PDL.

Given these specification changes, the results indicate that Anderson and Jordan's proposition (hypothesis) that the sum of the coefficients for the monetary policy variable is bigger is not rejected. But these results do not seem to agree with the remaining propositions that fiscal policy does not last longer and the sum of the coefficients for HEG is not significantly different from zero. The regression results in A.1 clearly indicate that fiscal policy, if appropriately specified, does have a significant influence on the nominal GNP. However, the sum of the coefficients

TABLE A-1

2SLSQ (INSTRUMENTAL VARIABLES)

	Δ M1B	Δ ActG	ΔX
0	3.02 (.84)	.12 (.48)	1.11 (3.79)
-1	.06 (.03)	1.32 (4.16)	.64 (1.41)
-2	2.84 (2.17)	-.15 (-.50)	-.65 (-1.99)
-3	.84 (.63)	.09 (.31)	-.11 (-.37)
-4	-2.15 (-1.74)	.26 (.92)	-.91 (-2.94)
-5	-.14 (-.09)	-.27 (-.98)	.01 (.04)
-6	1.63 (1.03)	.45 (1.73)	.84 (1.78)
-7	-2.24 (-1.34)	.47 (1.36)	.48 (1.02)
-8	.17 (.15)	.22 (.74)	-1.12 (-2.39)
Sum	4.03 (3.8)	2.52 (3.91)	.28 (.23)

Sample 1959I - 1979III

Instrumental variables: $\Delta\ M1B_{-1}$

$\Delta\ M1B_{-8}$

Δ ActG - Δ $ActG_{-8}$ ΔX - ΔX_{-8}, FFR, TBR, T

Constant = 1.74 (-.78) X = Exports D.W. = 1.61

TABLE A.2

SCHMIDT-WAUD MIN. S.E. ESTIMATES

	Δ MI	Δ HEG	Δ R
0	1.03 (1.27)	.34 (1.05)	.31 (.96)
-1	.96 (1.56)	.90 (3.08)	-.17 (-0.57)
-2	1.20 (2.85	.23 (1.07)	-.42 (-1.48)
-3	1.10 (2.51)	-.46 (-2.10)	-.44 (-1.54)
-4	.48 (1.14)	-.54 (-2.42)	-.28 (-1.03)
-5	-.39 (-.80)	.02 (.81)	-.07 (-.27)
-6	-.78 (-1.23)	.68 (2.42)	-.01 (-.04)
-7	.45 (.52)	.27 (.81)	-.37 (-.95)
Sum	4.05 (2.79)	1.43 (1.59)	-1.46 (-1.13)

Sample 1952I - 1968II

Constant = 4.40 (2.49)

S.e. = 3.84

$\bar{R}^2$ = .62

D.W. = 2.13

Reproduced from: Schmidt, Peter and Waud, Roger, "The Almon Lag Technique and The Monetary vs. Fiscal Policy Debate," _Journal of American Statistical Association_, March 1973.

for Δ ActG is smaller than ΔM1B. If the results in Table A.1 are compared with Table A.2 [Schmidt-Waud (1973)], it would seem that the sum of the coefficients for ΔM1B is very close to their (Schmidt-Waud's) estimates. This level of significance is higher in this regression than in Schmidt and Waud's. The main difference between A.1 and A.2 is that the sum of the coefficients for the fiscal policy variable is bigger in A.1 than in A.2. The Schmidt-Waud regression produced the fiscal multiplier of 1.43 over two years, but it is significant only at the .10 level. However, the fiscal multiplier in 6.1 is 2.52, which is significant at the .01 level. The sum of the coefficients for Δ ActG implies that with a constant money supply, a $1 change in government spending would bring a $2.52 change in the nominal GNP after nine quarters. Since the money supply is given, a change in government expenditures is expected to be financed by issuing new bonds. This would imply that the impact of bonds financed spending is smaller than that of money-financed spending. This contradicts Blinder and Solow's (1974) claim that bonds-financed government spending is more expansionary than money-financed spending. The evidence also does not support the claim by Stein and Infante (1976) that the overall fiscal multiplier will be negative.

APPENDIX B

This appendix includes the 2SLSQ estimates for the following specifications:

$$(1)\quad \Delta Y_t = \alpha_0 + \alpha_1 \sum_{i=0}^{9} \Delta\, M1B_{t-i} + \alpha_2 \sum_{i=0}^{9} \Delta\, ActG_{t-i} + \alpha_3 \sum_{i=0}^{9} \Delta\, A_{t-i} + U_i$$

$$(2)\quad \Delta Y_t = \beta_0 + \beta_1 \sum_{i=0}^{9} \Delta\, M_{2_{t-i}} + \beta_2 \sum_{i=0}^{9} \Delta\, ActG_{t-i} + \beta_3\, \Delta\, A_{y-i} + U_i$$

$$(3)\quad \Delta Y_t = \gamma_0 + \gamma_1 \sum_{i=0}^{9} \Delta\, UBR_{t-i} + \gamma_2 \sum_{i=0}^{9} \Delta\, ActG_{t-i} + \gamma_3 \sum_{i=0}^{9} \Delta\, A_{t-i} + U_i$$

$$(4)\quad \Delta Y_t = C_0 + C_1 \sum_{i=0}^{9} \Delta\, MB_{t-i} + C_2 \sum_{i=0}^{9} \Delta\, ActG_{t-i} + C_3 \sum_{i=0}^{9} \Delta\, A_{t-i} + U_i$$

The results are shown in Tables B.1 - B.4.

Table B.1: The sum of the coefficients for Δ M1B turn out to be 3.19 which is significant only at the .10 level. The sum of the coefficients for Δ ActG is 1.49 and is significant at the .01 level. Fiscal policy seems to do better than monetary policy in this specification. The multiplier for fiscal policy is not bigger, but is statistically more significant than for monetary policy.

Table B.2: None of the regressors seem to be doing well. Δ M2 does not show any significant influence on the nominal GNP. This is in considerable contradiction with Friedman, who considers M2 as a superior monetary aggregate. Under this specification the sum of the coefficients for M2 is significantly different from zero.

Table B.3: Similarly, UBRs do not seem to be doing any better. The sum of the coefficient is negative and is not significant statistically.

Table B.4: The base seems to be doing better in this case. The results are closer to Schmidt and Waud's. This implies that when A is included in the specification, none of the aggregates except the monetary base performs effectively. Fiscal policy still seems to maintain its effectiveness in some cases. The autonomous spending itself does not cause significant variation on the nominal GNP when regressed with M2. With M1B, the sum of the coefficients for A is significantly different from zero. The same is true with unborrowed reserves.

TABLE B.1

2SLSQ

	Δ M1B	Δ ActG	Δ A(X+I+CCA)
0	3.27 (1.77)	.27 (.81)	.53 (1.90)
-1	.73 (.35	.60 (2.89)	.20 (1.13)
-2	.59 (.51)	-.64 (-2.75)	-.24 (-2.19)
-3	1.67 (1.16)	.30 (1.43)	.000
-4	-2.16 (-1.20)	.10 (.49)	-.11 (-.99)
-5	3.15 (1.93)	.27 (1.38)	.09 (.97)
-6	-3.02 (-2.21)	.73 (2.50)	.36 (2.76)
-7	-.32 (-.27)	.05 (.13)	.24 (1.32)
-8	-.72 (-.76)	-.24 (-.79)	.23 (-1.70)
Sum	3.19 (1.46)	1.49 (7.34)	.84 (2.00)

Sample 1959I - 1980II

Instruments: Δ M1B$_{-1}$ - Δ M1B$_{-8}$,

Δ AG - Δ AG$_{-8}$

Δ A$_{-1}$ - Δ A$_{-8}$, FFR, TBR, T

D.W. = 1.89

TABLE B.2

2SLSQ

	Δ M2	Δ ActG	Δ A
0	3.93 (.56)	1.41 (.83)	2.16 (.90)
-1	-4.56 (-.53)	.88 (.97)	1.04 (.58)
-2	1.07 (.54)	.08 (.09)	-.41 (-.64)
-3	-1.59 (-.54)	-.33 (.28)	.16 (.38)
-4	2.10 (.45)	-.88 (-.44)	-.26 (-.84)
-5	-.09 (-.05)	.13 (.21)	-.07 (-.19)
-6	-1.25 (.46)	.62 (.51)	.95 (.60)
-7	.29 (.25)	-1.15 (-.51)	-.30 (-.47)
-8	-.58 (-.32)	.02 (.02)	-.11 (-.23)
Sum	2.14 (.18)	.73 (.16)	3.16 (.16)

Sample 1959I - 1980II

D.W. = 2.00

Instrumental variables $\Delta M_{2-1} - \Delta M_{2-8}$

$\Delta A_{-1} - \Delta A_{-8}$, Δ ActG - Δ $ActG_{-8}$

FFR, TBR, T

TABLE B.3

2SLSQ

	Δ UBR	Δ ActG	Δ A
0	14.88 (1.48)	1.072 (2.60)	1.62 (4.98)
-1	-4.17 (-.74)	1.11 (2.69)	.43 (1.68)
-2	5.33 (1.38)	-.35 (1.06)	-.00 (-.00)
-3	-12.49 (-2.39)	-.10 (-.29)	.03 (.19)
-4	2.88 (-.62)	-.50 (-1.07)	-.57 (-2.00)
-5	-4.35 (-.98)	.46 (1.52)	-.22 (1.44)
-6	-1.52 (-.37)	.26 (.76)	.14 (.93)
-7	4.99 (.99)	.39 (1.28)	-.11 (-.61)
-8	-8.35 (-1.92)	-.62 (-1.38)	-.25 (-1.57)
Sum	-2.79 (.19)	1.72 (2.97)	1.07 (1.88)

Sample 1959I - 1980II

D.W. = 1.94

Instructional variables FFR, TBR,

Δ UBR$_{-1}$ - Δ UBR$_{-8}$

Δ ActG - Δ ActG$_{-8}$, Δ A$_{-1}$ - Δ A$_{-8}$, T

TABLE B.4

2SLSQ

	Δ Base	Δ ActG	Δ A
0	-17.21 (-1.32)	.50 (1.59)	.97 (4.93)
-1	19.24 (2.51)	.29 (1.09)	-.05 (-.44)
-2	4.88 (.93)	-.28 (-1.01)	.17 (1.36)
-3	-.27 (-.06)	-.05 (-.19)	-.02 (-.15)
-4	3.17 (.68)	-.07 (-.26)	-.16 (-.19)
-5	9.09 (1.43)	-.08 (-.28)	-.11 (-.74)
-6	-2.17 (-.47)	-.25 (-.77)	.13 (1.08)
-7	-9.82 (-1.95)	.13 (.48)	-.03 (-.19)
-8	8.56 (1.62)	.31 (.75)	-.19 (-1.44)
Sum	15.47 (1.81)	.05 (.57)	.37 (.86)

Sample 1959I - 1980II

Instrumental variables Δ Base$_{-1}$

Δ Base$_{-8}$, Δ ActG - Δ ActG$_{-8}$

Δ A$_{-1}$ - Δ A$_{-8}$, FFR, TBR, T Constant = .71 (12.9)

APPENDIX C

Tables C.1 through C.3 show the OLSQ estimates for the following regressions:

(1) $$\Delta Y_t = \alpha_0 + \alpha_1 \sum_{i=0}^{9} \Delta M_{2_{t-i}} + \alpha_2 \sum_{i=0}^{9} \Delta ActG_{t-i} + \alpha_3 \sum_{i=0}^{9} \Delta X_{t-i} + U_i$$

(2) $$\Delta Y_t = \beta_0 + \beta_1 \sum_{i=0}^{9} \Delta UBR_{t-i} + \beta_2 \sum_{i=0}^{9} \Delta ActG_{t-i} + \beta_3 \sum_{i=0}^{9} \Delta X_{t-i} + U_i$$

(3) $$\Delta Y_t = \gamma_0 + \gamma_1 \sum_{i=0}^{9} \Delta Base_{t-i} + \gamma_2 \sum_{i=0}^{9} \Delta ActG_{t-i} + \gamma_3 \sum_{i=0}^{9} \Delta X_{t-i} + U_i$$

These tables have the following implications. (Note the above equations have all endogenous right-hand-side variables, therefore the OLSQ method is used.)

Table C.1: M2 and UBR do not have a significant influence on the nominal GNP. One needs to have a careful look at Friedman's (1963) and Deleeuw-Kalchbrenner's (1969) work. In these reduced form fiscal policy clearly seems to be doing better than monetary policy and the multiplier ranges from 1.0 to 3.35.

Table C.2: Only the monetary base has a significant influence on the nominal GNP.

Table C.3: The fiscal multiplier is 2.26, which is significant at the .05 level. One would recommend using monetary base, ActG and X as an alternative reduced form. These results are more in line with Keran (1969).

TABLE C.1

OLSQ

	Δ M2	Δ ActG	Δ X
0	.79 (2.44)	-.11 (-.45)	1.06 (3.94)
-1	.13 (.28)	1.07 (4.07)	.63 (2.16)
-2	.03 (.07)	-.25 (-1.03)	-.52 (-1.75)
-3	.13 (.29)	-.28 (1.14)	-.30 (-.92)
-4	-.13 (-.28)	.18 (.69)	-.97 (-3.21)
-5	-.66 (-1.38)	-.46 (-1.77)	-.18 (-.56)
-6	1.27 (2.61)	.19 (.77)	.62 (1.73)
-7	-.42 (-.92)	.14 (.56)	.47 (1.24)
-8	.37 (.07)	-.03 (-.14)	-1.25 (-2.50)
Sum	1.48 (1.12)	1.01 (1.16)	-.43 (-2.91)

Sample 1959I - 1979III

$\bar{R}^2$ = .89 Constant = -1.11
(-.62)

D.W. = 1.92

TABLE C.2

OLSQ

	Δ UBR	Δ ActG	Δ X
0	-.93 (-.24)	.30 (.97)	1.35 (3.98)
-1	7.66 (1.95)	1.49 (4.87)	.86 (2.24)
-2	4.42 (1.03)	.32 (1.04)	-.27 (-.65)
-3	4.94 (1.10)	.68 (2.10)	-.20 (-.46)
-4	-3.67 (-.83)	.25 (.74)	-1.29 (-2.92)
-5	.93 (.20)	-.67 (-1.95)	-.31 (-.73)
-6	-3.25 (-.66)	-.53 (-1.76)	.07 (.15)
-7	1.27 (.27)	.86 (2.94)	-.15 (-.33)
-8	-.33 (-.08)	.65 (2.07)	-.82 (-1.50)
Sum	11.04 (1.09)	3.35 (4.09)	-.76 (.55)

Sample 1959I - 1979II

$\bar{R}^2$ = .76 Constant = .30 (.09)

D.W. = 1.48

TABLE C.3

OLSQ

	Δ Base	Δ ActG	Δ X
0	4.41 (1.01)	.18 (.64)	.93 (3.34)
-1	4.40 (.95)	1.09 (3.83)	.34 (1.12)
-2	3.43 (.73)	.07 (.24)	-.67 (-2.15)
-3	9.10 (1.90)	.22 (.75)	-.68 (-2.01)
-4	-7.31 (-1.54)	.18 (.61)	-.84 (-2.46)
-5	7.44 (1.54)	-.45 (-1.53)	-.11 (-.33)
-6	1.18 (.24)	.25 (.94)	-.29 (.73)
-7	-6.83 (-1.40)	.67 (2.68)	-.04 (-.11)
-8	.91 (.20)	.06 (.21)	1.24 (-2.67)
Sum	16.65 (3.53)	2.26 (2.37)	-2.03 (-2.36)

Sample 1959I - 1979III

$\bar{R}^2$ = .89 Constant = -3.58 (-1.64)

D.W. = 1.73

REFERENCES

REFERENCES

Almon, S., "The Distributed Lag Between Capital Appropriations and Expenditures," Econometrica, January 1965.

Anderson, Leowell C. and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance In Economic Stabilization," "Review" Federal Reserve of St. Louis, November 1968.

_______, and Denis Karnosky, "Some Considerations in the Use of Monetary Aggregates for the Implementation of Monetary Policy," Federal Reserve Bank of St. Louis Review, September 1977, pp. 11-24.

Auerback, Robert D. and Jack L. Rutner, "Money and Income: Is There a Simple Relationship?" Federal Reserve Bank of Kansas City Monthly Review, May 1975.

Barth, James R. and James T. Bennet, "A Note On the Relationship Between FEBS and GNP," Economic Inquiry, September 1974, pp. 403-405.

Blinder, Alan S. and Robert M. Solow, "Economics of Public Finance," The Brookings Institution, Washington, D.C., 1974.

_______, "Does Fiscal Policy Matter?" Journal of Public Economics, Vol. 2, 1973.

_______, "Does Fiscal Policy Still Matter?: A Reply," Journal of Monetary Economics, Vol. 2, 1976.

Brunner, Karl and A.H. Meltzer, "An Aggregate Theory for a Closed Economy," in Monetarism, edited by Jerome Stein, (Amsterdam: North-Holland Publishing Co., 1976).

Cagan, Phillip, "The Choice Among Monetary Aggregates as Targets and Indicators for Monetary Policy," A paper presented for the American Enterprise Institute Conference on Current Issues in the Conduct of U.S. Monetary Policy, Washington, D.C., February 4-5, 1982.

Carlson, Keith M., "Does the St. Louis Equation Now Believe in Fiscal Policy?" Federal Reserve Bank of St. Louis Review, February 1978, pp. 13-19.

Cullison, William E., "Money, the Monetary Base and Nominal GNP," Economic Review, Federal Reserve Bank of Richmond May/June, 1982.

Davidson, Paul and Sidney Weitraub, "Money as a Cause and Effect," Economic Journal, December 1973.

Deleeuw, Frank and John Kalchbrenner, "Monetary and Fiscal Actions: A Test of Their Relative Importance In Economic Stabilization: Comments," Federal Reserve Bank of St. Louis Review, April 1969.

_______, Thomas M. Holloway, Darwin G. Johnson, Avid C. McClain, and Charles A. Waite, "The High Employment Budget: New Estimates 1955-1980," Survey of Current Business, November 1980.

Dent, Warren and John Geweke, "On Specification in Simultaneous Equation Models," Social Systems Research Institute Workshop Series Paper No. 7823, University of Wisconsin, Madison, 1978. Reprinted in J. Kmenta and J. Ramsey, Evaluation of Econometric Models (forthcoming).

Dernburg, Thomas F. and Duncan M. McDougall, Macroeconomics, Second Edition, McGraw-Hill, New York, 1963, Chapters 5, 6.

Dhrymes, P.J., Distributed Lags: Problems of Estimation and Formulation, San Francisco: Holden Day, Inc., 1971.

Elliot, Jan W., "The Influence of Monetary and Fiscal Actions on Total Spending: The St. Louis Total Spending Equation Revisited," Journal of Money, Credit and Banking, May 1975.

Feige, Edgar L. and James M. Johannes, "Testing the Causal Relationship Between the Domestic Credit and Reserve Components of a Country's Monetary Base," Journal of Macroeconomics, Winter 1981, pp. 55-76.

Friedman, Benjamin M., "Even the St. Louis Model Now Believes in Fiscal Policy," Journal of Money, Credit and Banking, May 1977.

Friedman, Milton and David Meiselman, "The Relative Stability of Monetary Policy and Investment Multiplier in the United States 1897-1959," in Commission on Money and Credit, Stabilization Policies, Englewood Cliffs, Prentice-Hall, 1963, pp. 160-270.

Fromm, Gary, and Lawrence R. Klein, "A Comparison of Eleven Econometric Models of the United States," AEA Papers and Proceedings of the Eighty-fifth Annual Meeting 1972," American Economic Review, May 1973.

Geweke, John, "Testing the Exogeneity Specification in the Complete Dynamic Simultaneous Equation Model," Journal of Econometrics, April 1978, pp. 163-185.

Goldfield, Stephen M. and R. Quandt, "Some Tests for Heteroscedasticity," Journal of American Statistical Association, September 1965.

Granger, C.W.J., "Investigating Causal Relations by Econometric Models and Cross Spectral Methods," Econometrica, July 1969, pp. 428-438.

Griliches, Zvi, "Distributed Lags: A Survey," Econometrica, January 1967.

Gujarati, Damodar, Basic Econometrics, McGraw-Hill, Inc., 1978.

Hafer, R.W., "Selecting a Monetary Indicator: A Test of New Monetary Aggregate," Federal Reserve Bank of St. Louis Review, February 1981, pp. 2-18.

_______, "The Role of Fiscal Policy in the St. Louis Equation," Federal Reserve Bank of St. Louis Review, January 1982.

Hansen, Alvin, Business Cycles and National Income, New York 1951.

Hester, Donald D., "Keynes and the Quantity Theory: A Comment on the Friedman-Meiselman CMC Paper," Review of Economics and Statistics, November 1964, pp. 364-368.

Infante, Ettore F. and Jerome W. Stein, "Does Fiscal Policy Matter?" Journal of Monetary Economies, Vol. 2, 1976.

Johannes, James M., "Testing the Exogeneity Specification Underlying the Monetary Approach to the Balance of Payments," The Review of Economics and Statistics, 1980.

Keran, Michael W., "Monetary and Fiscal Influences on Economic Activity: The Historical Influence," Federal Reserve Bank of St. Louis Review, November 1969.

Kelejian, Harry H. and Wallace E. Oates, Introduction to Econometrics: Principles and Application, Harper and Row, 1974.

Kmenta, Jan, Elements of Econometrics, MacMillan Publishing Co., New York, 1971, Chapter 13.

Macrowitz, Seth P., "The Market for Federal Funds," Federal Reserve Bank of Richmond Economic Review, July/Aug., 1981, pp. 307.

Modgliani, Frank and Albert Ando, "Impact of Fiscal Actions on Aggregate Income and the Monetarist Controversy: Theory and Evidence," in Monetarism, edited by Jerome W. Stein, North-Holland Publishing Co., 1976.

Moroney, J.R. and J.M. Mason, "The Dynamic Impacts of Autonomous Expenditures and the Monetary Base on Aggregate Income," Journal of Money, Credit and Banking, November, 1971.

Okun, Arthur M., Rules and Roles for Fiscal and Monetary Policy: Current Issues In Monetary Theory and Policy, edited by Thomas M. Havrilsky and John T. Boorman, AHM Publishing Co., 1976, pp. 509-588.

Pierce D.A. and L.D. Haugh, "Causality in Temporal Systems Characterization and a Survey," Journal of Econometrics, May 1977, pp. 265-293.

Samuelson, Paul A., Economics, 5th edition, New York, 1961, pp. 250.

Schadrack, Frederick C., "An Empirical Approach to the Definition of Money, Monetary Aggregates and Monetary Policy," Federal Reserve Bank of New York Quarterly Review, 1974.

Schmidt, Peter and Roger Waud, "The Almon Lag Technique and the Monetary vs. Fiscal Policy Debate," Journal of the American Statistical Association, March 1973.

Silber, William, "Fiscal Policy in IS-LM Analysis: A Correction," Journal of Money, Credit and Banking, November 1970.

Simpson, Thomas D., "The Market for Federal Funds and Repurchase Agreements," Board of Governors of the Federal Reserve System, Washington, 1979, p. 20.

Sims, Christopher A., "Money, Income and Causality," American Economic Review, September 1972, pp. 540-552.

Smith, Warren L., "A New Keynesian View of Monetary Policy," in Money Supply, Money Demand, and Macroeconomic Models, edited by John T. Boorman & Thomas M. Havrilesky, AHM Publishing, 1972.

Stephens, J. Kirker and Terry Grapentine, "The Relationship Between FEBS and GNP: Comment," Economic Inquiry, April 1979.

Willis, Parker B., "Fed Funds Market: Its Origin and Development," Federal Reserve Bank of Boston, 1970.