MONETARY SUPPLY AND INTEREST RATES: AN ANALYSIS OF THE TRINIDAD AND TOBAGO CASE JANUARY 1970 TO DECEMBER 1980

BY

W. JOEFIELD-NAPIER

Paper Presented at the Thirteenth Annual Regional Monetary Studies Conference, Trinidad, 24-28 November 1981.

Institute of Social & Economic Research,
U.W.I.,
St. Augustine.

I wish to acknowledge the help of Mr. E. Adams in the collection of the data. I also benefited from a fruitful discussion with Dr. H. Addo on the causality phenomenon.

MONETARY SUPPLY AND INTEREST RATES: AN ANALYSIS OF THE TRINIDAD AND TOBAGO CASE JANUARY 1970 TO DECEMBER 1980

For the last several years, during which the new found monetary policies of Central Banks in developing economies have been impotent in facilitating meaningful economic growth, and the conventional notion of a trade-off between rapid growth in the money supply and expansion of a decentralised economy has become ineffective, many developing economies - for instance, Trinidad and Tobago, had witnessed the worst combination of high growth in money supplies and economic disequilibria in their histories. What few economists do not seem to realize is that economic disequilibria and monetary problems are not the exclusive preserve of developing economies, since developed economies such as the U.S.A., Canada, Britain and Germany have all experienced similar problems. Nevertheless, in view of the importance of the relationship between the imposition of various monetary measures and economic growth, any investigation into the nature and length of the lag between the execution of monetary measures and the effect on disequilibrium in the structure of an economy, especially in areas such as output and employment, is of some importance. However, the evaluation of the impact of any monetary measure (policy) is a complex and difficult undertaking, since it requires that the behaviour of money supply and/or demand under a particular policy be compared with the hypothetical behaviour which would occur in the absence of the particular policy or measure. One way to estimate what this hypothetical behaviour would have been is to fit an econometric

model or money supply and/or demand to the pre-control period, and then estimate the model for the control period to determine what would have happened without the imposition of a particular monetary measure or policy, and, next, compare the estimated behaviour of the specific model with the actual behaviour while controls were in effect. The problem lies, however, in choosing the proper econometric model in determining the impact of monetary policy changes on the structure of a given economy.

Briefly stated, there are several reasons why the adoption of an econometric approach is beneficial. We will only examine a few of these here. First, developing the equations of an econometric model requires a systematic specification of the proposed relationship among economic measures, this specification aids in conceptualizing alternative hypotheses and drawing attention to areas of disagreement. Second, applying empirical alternative models allows a comparison of their properties and the explanatory power of the hypotheses underlying them. In other words, it permits both replication with other data sets to test for generality and transfers of variables among models to study how their impacts depend on the context in which they are used. Third, once a model has been estimated, simulating it provides a means of preparing forecasts and evaluating alternative policies. Additionally, by making changes (minor or major) in the values assigned to individual variables and observing whether simulated outcomes change significantly, the sensitive variables which have important consequences for forecasts and policy proposals can be distinguished from the other variables.

Over the years a large number of econometric studies have appeared which attempt to guage the impact of monetary policies in developing economies. Based on a plethora of competing theories and models, these efforts have taken many forms. Some have focussed on the effects of changes in monetary policies on interest rates, while others have focussed on the effects of such policies on national income. Nonetheless, most if not all, of the attempts which have been made to identify and distinguish the relative importance of alternative forces, theorized to influence the monetary policy transmission mechanism, have largely been unsuccessful empirically.

The most widely tested hypothesis postulates that monetary policy action impinges on the level of economic activity, but with a long time lag. Friedman (1958, 1961) who authored the first widely read study of this type analysed time series data and compared rates of growth with turning points in the level of economic activity for the United States. He found, on the average eighteen non-war cycles, since 1870, that: (i) peaks (turning points in the rate of change of the money supply preceded peaks in the level of economic activity by an average of sixteen months and (ii) trough in the rate of change of the money supply has preceded trough in the level of economic activity by an average of twelve months. Additionally, he found that there was a great deal of variation between business cycles, with a standard deviation of approximately six to seven months for the time lag between turning points in the rate of change of the money supply and the level of economic activity.

Criticisms of Friedman's work on both methodological and statistical grounds have precipitated the development of alternative tests of the

monetary policy mechanisms. More specifically, with reference to Friedman's methodology, Culbertson (1960, 1961) and Kercken and Solow (1963) have questioned whether the association found between money and economic activity justifies the inference of a causal relationship. Insofar as their criticisms of the statistical procedure adopted by Friedman was concerned, these were levelled at the way in which he (Friedman) measured the time lag by analysing turning points in the rate of change of money supply against the level of economic activity. In fact, in a subsequent test of the monetary policy mechanism, Kercken and Solow found no uniform level of monetary changes over changes in the level of economic activity. Consequently, the aforementioned authors concluded that monetary changes and changes in the level of economic activity moved approximately simultaneously.

Despite that fact that most of the empirical work on the money supply - income relationship have been carried out for the United States economy, there have been a number of studies involving other developed economies. For instance, Crockett (1970) in a study of the United Kingdom concluded that movements in the money supply generally preceded movement of money income, but that the pattern of this level - by relationship was bi-model. To be more precise, Crockett found that there was a fairly strong correlation between the money supply and money income, when money supply had a very short lag of approximately two-three months over money income. Even though, a further peak in correlation has not been firmly established within the neoclassical monetary theoretic framework expounded by Friedman, increasing attention has been paid to the hypothesis that the rate of interest is the

major vehicle for transmitting monetary policy operations to their ultimate output and employment targets. This because it is felt that interest rates link the real and financial sectors of an economy. Essentially, this hypotheses, which is Keynesian in origin, sees the changes in money supply as affecting the long term end money markets. In turn, such changes lead to alternations in long term yields which will bring about a divergence between the cost of capital and the return of capital, and thereby precipitate changes in expenditure decisions. As such, the effects of changes in the money supply upon expenditure decisions is regarded as taking place by way of changes in interest on financial assets stemming from the initial monetary disturbances. This transmission impact of monetary policy, usually approximated by the rates of interest of government's security of various maturities, has been tested in two versions. The simpler version exemplified in the work of Gibson (1970), postulates a linear relationship between interest rates and money supply lagged several periods. The more sophisticated version proposes the use of the real rate of interest - that is, the nominal rate of interest minus price expectations - as arguments in expenditure functions. The use of real interest rates has been explained on the basis of "expedition of future quasi-rents, in nominal terms, from capital investments will vary with expectations of future movements in output, prices, and wages etc., and these expectations will depend on moods, confidence and state of mind... so that, what one needs to measure in the effect on the demand for real assets of a rise in financial interest rates *relates* to the level of its own yields." See Goohart (1975, p.184). Both forms of the interest rate approach have

been criticised because of the double causality between money supply and interest rates and the inability to seperate out the sources of the causality.

Finally, it may be noted that a number of studies have opted for a wider definition of the money supply in the analyses of the transmission mechanism of monetary policy on the rationale that the money supply should be regarded as an endogeneous variable reflecting the behaviour of banks as well as other financial units. In other words, it was felt in these studies that rather than concentrating on the relationship between the quality of money and money income, attention should be focussed on the impact of monetary policy on the demand for and supply of a whole spectrum of assets, asset yields, and the availability of credit. Girley and Shaw (1956) have taken this approach to its logical extreme, based on Tobin (1963) classical argument that an investigation of financial control rather than monetary control is needed in order to gauge the effectiveness of monetary policy on influencing the level of economic activity.

There are other issues which are germane to the measurement of monetary policy which we will not go into, suffice it to say that based on the empirical ability of the many theories to explain the transmission mechanism of monetary policy, it appears, that a number of the competing theoretical and empirical framework can be characterized at best, as equally capable. Choosing among the conflicting views of the transmission mechanism of monetary policy presented in various models has proven a confounding problem. In fact as we have indicated before, different studies have used different data sources, different time periods and

even different definitions of what appears to be nominally identical variables in analysing the mechanism through which monetary policies impinge on the economy. Both our reading of the theoretical and empirical literature suggest that the alternative explanations are neither unique nor complete and that analysing the mechanism of monetary policy is more context specific than universally precise. Owing to the uniqueness of the economic problems of developing economies such as Trinidad and Tobago, there have simply not been enough data on repetitions of similar money market conditions with which to distinguish among alternative explanations of the transmission mechanism of monetary policy.

SCOPE OF THE STUDY

In this study, we develop a money supply model of the Trinidad and Tobago economy. Our purpose is twofold. First, our concern is not analyse the money supply process as a whole, but in choosing among specific hypotheses regarding money supply in an open economy. Second, and more important, we want to assess the degree of association and timing relationship between monetary policy operations and interest rate changes, ideally using spectral techniques. If as Keynesian theorists assert, interest rate link the real and financial sectors of the economy, then it is important to establish the extent to which monetary operations have influenced the movements in interest rates.

Similarly, if as the monetarists assets that monetary policy is effected through the control of high power money, and by implication excess reserves of commercial banks, it is also important to investigate

the relationship between the components of money supply. The primary hypotheses under investigation are the following:

(a) that interest rate variations are related to money supply variations in a simple causal fashion so that changes in interest rates follow the change in money supply and

(b) that high power money and excess reserves are also related to money supply in the same simple causal way.

If the assumed 'one-way' causal relationship between interest rates and money supply exists and is stronger than that between high power money and money supply, then interest rate may be used as an indicator of monetary policy. If the converse situation holds, movements in high power money and/or excess reserves should provide fairly reliable information about the thrust of the Central Bank's monetary policy operations. Although these two hypotheses are extremely simple, by-passing most of the controversial issues in monetary theory such as selecting targets and indicators they are nonetheless appropriate as working hypotheses.

The procedure that we shall follow in testing the hypotheses will be to examine the lag, relationship between a money supply equation which will be specified below, and its arguments. Basically, the technique which will be used as a measure of the lead-lag relationship between money supply both narrowly and broadly defined, their components, and various interest rate series is Gibson's (1970) test. If there are important linkages between money supply, high power money, and excess reserves as the monetarists

hypothesized, then one would expect to find the money supply series to lag the others. Similarly, when the analyses is extended to include interest rate changes, if the hypothesis forwarded by Keynesian theorists is valid, then we would expect the interest rate series to lead the money supply series.

The rest of the paper is structured along the following lines. In Section II we develop a money supply model (equation) for the Trinidad and Tobago economy. In Section III, we discuss briefly Gibson's test as well as the data used in the analysis. In Section IV we present our estimates and a brief discussion of the estimated equations. The final Section presents a general summary of the results and an examination of the economic implications of the analysis.

SECTION II. A MODEL OF THE MONEY SUPPLY PROCESS IN TRINIDAD AND TOBAGO

Before looking at the relationship between money supply and interest rate changes, a model of the money supply will be developed to aid in the establishment of clear definitions. This model serves as a point of reference for later elaborations, and its strategic simplifications should clarify how several forces interact to produce specific monetary policy reactions. Additionally, the formulation of the model allows operations for which no manageable verbal equivalents exist and the concepts and relationships most crucial to particular forms of the monetary authority's policy behaviour can be presented in a rigourous and orderly manner.

We begin with a discussion of the treatment of money supply as an exogeneous variables.

The hypothesis that money supply is an exogeneous variable has been based, essentially, on the assumption that a Central Bank controls the total monetary base (currency plus reserves) which in turn controls the supply of money through the behaviour of the public in determining the ratio of currency to money supply, and, correspondingly, of commercial banks in determining the ratio of reserves to deposits. In the context of very little variations the above mentioned ratios, money supply may be regarded as an exogeneous variable. Many economists, however, have pointed to significant variations in the two ratios, especially in developing economies such as Trinidad and Tobago.

The variations in these ratios may be conceptualized as being due to a host of factors, many of which may be outside of the control and/or influence of the monetary authorities. For instance, the propensity to hold currency out of a given stock of money depends, among other factors, on the interest rates on bank deposits (positive or negative), the institutional development of banking, and banking habits. The importance of these factors in currency - money supply relationship for the U.S. and the U.K. have been clearly highlighted. An examinations of three approaches to the modern theory of money supply is also of some interest on the specification of the money supply relationship. Thus we note that Brunner (1961) and Crouch (1968) derived a money supply theory from the analysis of the micro-behaviour of individual commercial banks. Broadly, they concluded that money supply is a function of the monetary base, the ratio of currency to deposits and the reserve ratio.

Showing this development Teigen (1964) in an extension of the earlier work of Polak and White (1955), introduced interest rates as explicit variables in the money supply function. Teigen argues that the ratio of the total money supply to money supply directly controlled by the Central Bank is a function of the short term interest rate and the discount rate. Lastly Hays (1962) developed a money supply function in the tradition of the capital theoretic framework and has concluded that the rate of desired free reserves to deposits is a function of the interest rates and the discount rates.

Neither of the preceding theoritical framework describes the Trinidad and Tobago situation adequately. For one, since the savings propensity has been relatively lower than the propensity to invest over an extended period, commercial banks in need of funds deliberately resorted to external borrowings to offset this discrepancy. The growing demand for bank credit could not, invariably, be met from their domestic deposit resources. A major reason why commercial banks resorted to overseas borrowings was the relatively underdeveloped rate of the local security market. But a secondary reason was the traditional sharp seasonal variation in the demand for credit in Trinidad and Tobago. More specifically, during periods of festivities such as Christmas and Carnival, the demand for money and moreso currency increases, sharply and in slack periods it falls. Commercial banks faced with a heavy presure on their liquidity position because of the increase in demand for money during the busy periods mentioned above, frequently borrowed overseas in order to improve their liquidity positions and they (the banks) repay the loans when demand has fallen.

Usually commercial banks like many other enterprises operates under some elements of uncertainty. Such uncertainties may be related to seasonality, in which case it is predictable to some extent. Or, uncertainty may be related to cyclical variations, in which case it is unpredictable. Note also that uncertainty may be due to the direction and magnitude of shifts in the current interest rate structure and this facet of uncertainty relates, naturally, to the market value of the non-matured securities in the bank's portfolio.

Given these above-mentioned uncertainties, a commercial bank requiring funds at short notice has two options open to it: first, it can transform a relatively illiquid asset - that is, a security - into an eligible asset, or secondly, it can simultaneously incur liabilities and require assets of the same general maturity on the average.

The relationship between a given commercial bank's lending and borrowing operations can be depicted by the simplified balance sheet below:

$$DD + CBR_C + CBB_L + CBB_O = CRR + CER + CVA$$
$$CLB_L + CLB_O + GSE + ALA \qquad (1)$$

where DD represents total deposits; CBR_C the commercial bank's borrowings from the Central Bank; CBB_L the borrowings from other local banks; CBB_O the borrowings from commercial banks outside of the domestic economy; CLR, CER, CAS are the commercial bank's required reserves, the excess reserves and cash in vault respectively; CLO represents lending to other commercial banks locally and overseas respectively; GSE denotes its government's security port-folio and ALA strands

for all loans and advances.

Subject to various constraints such as liquidity ratio, borrowing terms and costs, etc., a commercial bank can hedge against an increase in demand for loanable funds. It can do so by employing some general mechanism for hedging which is used in other markets. Hedging can be achieved by varying items on both sides of the bank's balance sheet. More specifically, the hedging mechanism operates through the identical response of an asset and an offsetting liability to the contingency hedge agreement so that net worth remains unchanged with respect to that contingency. To hedge against an increase demand for funds, a commercial bank can vary any of its CbR_c, CBB_L, CbL_o, CEX, CVA, CSE. When the domestic components of the balance sheets of all banks are consolidated inter-banks deposits and inter-bank borrowings would cancel out. Consequently, equilibrium, the banking system as a whole can adjusts its portfolio only with respect to the central bank, the public, and foreign banks. The money supply function developed is thus based on the assumption that commercial banks within Trinidad and Tobago adjust their portfolios to optimize their profits; and these adjustments in turn affect the supply of money independently of the action of Central Bank. We also have the substantive hypothesis that Central Bank controls the total monetary base, defined as currency 'C' plus reserves TC - that is, BM = CUR + TR where BM represents base money; CUR total currency and TR total reserves.

The components and sources of the monetary base are summarised in Table I.

TABLE I

COMPONENTS AND SOURCES OF THE MONETARY BASE

COMPONENTS	SOURCES
CRR: Required Reserved	CSE: The Central Bank Holdings of Government's Securities
CER: Excess Reserves	CBL_r: Borrowing by banker domestically
Cur: Currency	CBL_o: Borrowing by banks internally
	CFEX: Gold, foreign exchange reserves, etc.

If we define the unborrowed monetary base as

$$U = CSE + CFEX, \qquad (2)$$

then the relationship between the components and sources of the monetary base can be depicted as follows:

$$CRR + CER + Cur = CSE_o + CBL_o + U \qquad (3)$$

The preceding relationship can be rearranged as

$$U = CRR + CER - (CBL_o + CBL_o) + Cur \qquad (4)$$

Now since M = Cur + DD the relationship between commercial bank's required resources and total deposits could be written as follows:

$$CRR = \delta D$$
$$+ \delta M - \delta Cur \qquad (5)$$

where δ represents the reserve ratio.

Because of the demand for currency by the public out of a particular supply of money is influenced by unquantifiable as well quantifiable factors, such as banking habits and the interest rates charges on deposits, without loss of generality we may assume a simple relationship

between currency and money supply as:

$$Cur = mH$$

With respect to excess reserves held by commercial banks, these are held to safeguard commercial banks against any risk involved in the creation of deposits. As such, if the cost of borrowing reserves, i^1, rises, the tendency would be for banks to hold higher amounts of excess reserves. Conversely, if the yield on the most alternative interest earning required asset in a commercial bank's portfolio, say "i", rises, the tendency would be towards the minimization of excess reserves, CEX. In the case of commercial banks borrowings the reaction to changes in the cost of funds will be exactly opposite to the situation outlined above. In other words, since the cost of creating deposits through borrowing reserves is reflected in "i^{d_m}", then if this cost exceeds the yield on alternative liquid asset, "i" banks would borrow less from the Central Bank as well as from foreign banks. Based on the preceding analysis, we can thus define free reserves, CFR, as:

$$CFR = CEX - (CBB_{f} + CBB_{c}) \qquad (6)$$

or

$$y^i = i^1 - i \qquad (7)$$

assuming a direct relationship between free reserves, CFR, and the difference in the cost and the yield, "y^{i_m}". Another variable of primary importance in the specification of the free reserve relationship is the liquidity position of banks which is measured by the ratio of liquid assets to deposits. We define this variable as Lq. As 'Lq' increases commercial banks are in a relatively better position to face uncertainty and so are better able to substitute interest earning assets for excess reserves. Similarly, a higher liquidity ratio implies that commercial banks posses

a surplus of liquid assets over any statutory limit prescribed by the Central Bank and this could be converted into interest earning assets at their convenience.

Bearing in mind the preceding considerations the relationship between free reserves and the liquidity ratio as well as the difference between the cost and yield of liquid assets could be written as:

$$CFR = f(CEX\ (OSB_L - OSB_c)$$

$$= f(y^i,\ Lq)$$

The final version money supply relationship could be obtained by combining equations (5), (6) and (7) with equation (4) Rearranging and solving for "M" we get

$$M = F(U,\ y_s^i\ Lq)$$

where $\frac{\partial M}{\partial U} > o \quad \frac{\partial M}{\partial y^i} < o$

and $\frac{\partial M}{\partial Lq} >$

The money supply function postulated in the preceding equation is different from that of Tiegen in the sense that while Tiegen function determines the ratio of actual money supply to the potential money supply based on unborrowed reserves as a function of interest rates differential, the function specified determines the total money supply. In a like manner, our money supply function differs from that of Brunner (1961) in that interest rates are introduced as explicit variables in the function.

ESTIMATION OF THE LAG (OR FEEDBACK) EFFECTS IN THE MONEY-INTEREST RATE RELATIONSHIP

Having specified what we consider to be an appropriate representation of the money supply equation for Trinidad and Tobago, the next task at hand is to investigate whether or not there are unidirectional feedbacks among the different variables. More specifically, we intend to test the hypothesis that there are feedback relationships between money stock and interest rates, as well as between the monetary base and money stock, and the monetary base and interest rates.

As will, of course, be recognised there are a variety of ways in which hypotheses about causality can be tested. For instance, one can apply Sims (1970) causality test, or one may use spectral techniques. The problem with these testing procedures, however, is that they require adequate computing facilities which, unfortunately, were unavailable when this paper was written. Consequently, in the absence of the aforementioned facilities, it seems worthwhile to exploit a much more simple test such as that suggested by Gibson (1970). With respect to the latter test, it may be noted by the reader that its applicability rests on the theoretical argument that changes in the stock of money have three main effects on money market interest rates (liquidity, income, and price expectations) and these are not once and for all changes. Most obviously, the test is nothing more than a procedure for measuring the response of each of the preceding effects.

In order to implement Gibson's test it is necessary to estimate equations

of the following form:

$$(1) \qquad i = f \left[\left(\frac{1}{P} \frac{\partial M}{dt} \right) ; \left(\frac{1}{P} \frac{dM}{dt} \right)_{t-1} \right.$$
$$\left. \ldots \left(\frac{1}{P} \frac{dM}{d_t} \right)_{t-n} \right]$$

$$(2) \qquad i = G \left[\left(\frac{1}{UBM} \frac{d\ UBM}{dt} \right); \left(\frac{1}{UBM} \frac{d\ UBM}{dt} \right)_{t-1} \right.$$
$$\left. \ldots \left(\frac{1}{UBM} \frac{d\ UBM}{dt} \right)_{t-n} \right]$$

$$(3) \qquad UBM = I \left[\left(\frac{1}{P} \frac{dM}{dt} \right) ; \left(\frac{1}{P} \frac{dM}{dt} \right)_{t-1} \right.$$
$$\left. \ldots \left(\frac{1}{P} \frac{dM}{dt} \right)_{t-n} \right]$$

where "i" represents the money market rate of interest, and the other variables have been defined previously.

It may be pointed out that Gibson enunciated explicitly that the estimated coefficient on his current monetary change variable $\left(\frac{1}{P} \frac{dM}{dt} \right)$ - or any other current period variable in the argument of his equation - represents the immediate effect on the dependent variable brought about by changes in monetary policy. If the coefficient attached to the variable is negative then he postulated that this would be conclusive evidence that liquidity effects predominates. Conversely, if other effects - mainly income and price expectation effects - predominate the estimated coefficient will be positive.

The preceding equations were fitted to monthly data extending over the period January, 1970 through December 1979.

TABLE 1

RELATION BETWEEN UNCORRECTED MONEY AND CURRENCY AND PAST RATES OF CHANGE OF MONEY STOCK, MONTHLY OBSERVATIONS, 1970-1979

$$DM1_t = 0.0003 - 0.0004\ DM1_t - 0.003\ DM1_{t-1} - 0.0042\ DM1_{t-2}$$
$$(0.0001)\quad (0.0004)\qquad (0.001)\qquad (0.003)$$

$$- 0.001\ DM1_{t-3} - 0.002\ DM1_{t-4} - 0.0001\ DM1_{t-5}$$
$$(0.003)\qquad (0.003)\qquad (0.0003)$$

$$+ 0.0003\ DM1_{t-6} + 0.0007\ DM1_{t-7} + 0.0001\ DM1_{t-8} + .0005\ DM1_{t-9}$$
$$(0.000)\qquad (0.0000)\qquad (0.0002)\qquad (0.0003)$$

$R^2 = 0.127 \quad DW = 0.91$

$$UDM = - 0.0003 - 0.0004\ DM1_t - 0.003\ DM1_{t-1} + .0007\ DM1_{t-2}$$
$$(0.0001)\quad (0.0021)\qquad (0.001)\qquad (0.006)$$

$$- 0.0003\ DM1_{t-3} - 0.004\ DM1_{t-4} - 0.005\ DM1_{t-5}$$
$$(0.0001)\qquad (0.007)\qquad (0.008)$$

$$- 0.007\ DM1_{t-6} - 0.0003\ DM1_{t-7} + 0.0004\ DM1_{t-8} - .001\ DM1_{t-9}$$
$$(0.021)\qquad (0.005)\qquad (0.0008)\qquad (0.007)$$

$R^2 = 0.032 \quad DW = 1.024$

TABLE 3

RELATION BETWEEN UNBORROWED BASE MONEY AND CURRENT AND PAST RATES OF CHANGE OF MONEY STOCK, MONTHLY OBSERVATIONS

$$i^{t\,b} = -0.001 - 0.012\ DM1_t - 0.025\ DM1_{t-1} - 0.002\ DM1_{t-2}$$
$$(0.002) \quad (0.010) \quad (0.011) \quad (0.034)$$

$$0.0003\ DM1_{t-3} + 0.004\ DM1_{t-4} + 0.001\ DM1_{t-5}$$
$$(0.0010) \quad (0.003) \quad (0.002)$$

$$0.007\ DM1_{t-6} + 0.028\ DM1_{7-7} + 0.006\ DM1_{t-3} + 0.004\ DM1_{t-9}$$
$$(0.006) \quad (0.31) \quad (0.07) \quad (0.003)$$

$$R^2 = 0.055 \quad DW = 0.053$$

$$LRI = -0.0015 + 0.004\ DM1_t - 0.006 - DM1_{t-1}$$
$$(0.052) \quad (0.003) \quad (0.006)$$

$$-0.003\ DM1_{t-2} - 0.007\ DM1_{t-3} - 0.027\ DM1_{t-4}$$
$$(0.002) \quad (2.009) \quad (0.008)$$

$$0.031\ DM1_{t-5} - 0.075\ DM1_{t-5} - 0.023 + DM1_{t-6}$$
$$(0.004) \quad (0.033) \quad (0.100)$$

$$-0.073\ DM1_{t-7} + 0.077\ DM1_{t-;} - 0.074\ DM1_{t-9}$$
$$(0.086) \quad (0.092) \quad (0.025)$$

$$R^2 = 0.073 \quad DW = 0.041$$

various test statistics; and

(b) that to provide more conclusive evidence on the hypothesis that there is a 'feedback' relationship between money stock and interest rates, a variety of alternative models and estimation procedures must be tried. This is being done at present and until this exercise is completed we consider our findings to be highly tentative.

SUMMARY AND CONCLUSIONS

This paper has been concerned with a time series analysis of the effects that monetary policies have on money supply and interest rates. And although our discussion has not been phrased in terms of specific policies, we still feel that our tentative findings is of some importance since it points to an area of fruitful research. The first conclusion that could be reached is that there seems to be some 'feedback' between changes in money supply and changes in interest rates.

Turning now to the question of the specification of money supply models and/or equations, our analysis has suggested that the direction of causality must be firmly established before a theoretical construct could become a substantial aid to policy.

Finally, in our consideration of the possible length of the lag of monetary policy or interest rates, we produce some evidence that this would be much less than a year. It is clear, however, that because of the apparent shortcomings in the estimation procedure that no firm conclusions can be drawn from this single piece of evidence.

REFERENCES

1. Brunner, K. (1961) "A Schema for the Supply of Money", International Economic Review.

2. Cagan, P. (1958) "The Demand for Currency Relative to the Total Money Supply", Journal of Political Economy.

3. Culbertson, J. (1960) "Friedman on the Lag in Effect of Monetary Policy", Journal of Political Economy

4. _____ (1961) "Reply" (to M. Friedman, The Lag in Effect ...) Journal of Political Economy

5. Friedman, M. (1958) "The Supply of Money and Changes in Prices and Output", in The Relationship of Prices to Economic Stability and Growth: Compendium of Papers Submitted by Panelists, U.S. Congress, Joint Economic Committee.

6. _____ (1961) "The Lag in the Effect of Monetary Policy", Journal of Political Economy.

7. Gibson, W. (1970) "The Lag in the Effect of Monetary Policy on Income and Interest Rate", in Quarterly Journal of Economics.

8. Gurley, J. and Shaw, E. (1960) Money in a Theory of Finance, Brookings Institution.

9. Meraken, J. and Slow, R. (1964) "Lags in Monetary Policy", Commission on Money and Credit, Stabilisation Policies. Prentice Hall.

10. Sims, C. (1970) "Money, Income and Causality", American Economic Review.

11. Teigen, R. (1964) "Demand and Supply Functions for Money in the United States", in Econometrica

12. Tobin, J. (1958) "Liquidity Preference as Behaviour Towards Risks", Review of Economic Studies.