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The causality relationship between money supply and economic activity indicators in Nigeria

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THE CAUSALITY RELATIONSHIP BETWEEN MONEY SUPPLY AND ECONOMIC ACTIVITY INDICATORS IN NIGERIA

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To my parents -

Mr. and Mrs P. E. Asogwa.

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ABSTRACT

The focal problem of this study is to investigate the causality direction of influence between money supply and GNP, and between money supply and the price level, both GNP and the price level as indicators of economic activity in Nigeria. Previous empirical studies have made use of correlation analysis. This is questionable because the finding of a high correlation among variates does not in any necessary sense establish that they are causally related. The present study uses test of causation originally devised by Granger (1969) and later varied and applied in a study by Sims (1972) to determine the direction of causation between money supply and these measures of economic activity in Nigeria. It also tests whether feedback of any kind is occurring between the variables.

The study relies on time series data for the period, 1970-1988. Two measures of money supply (M_1 and M_2) are used, thus making it possible to test the influence of the different components of money supply on economic activity.

It is found that changes in money supply lead to

changes in the level of prices. The empirical results also show that feedback exists from the price level to money supply. This indicates that part of Nigeria's inflation can be traced to changes in quantity of money. The study also shows that the different components of money supply (M_1 and M_2) affect GNP in different directions. The empirical findings are further applied to a number of empirical and theoretical issues: the influence of the structure of the economy, the exogenity of money supply, explanation for 'wrongly' signed coefficients in regression models.

The evidence from this study points to the fact that the conduct of monetary policy aimed at influencing the composition of output or the level of prices in a developing economy such as Nigeria characterized by structural rigidities and some other imperfections may be an ardous task.

INTRODUCTION

It has become conventional in a number of countries that the rate of growth of money supply must be controlled to achieve economic stability and growth. Thus the authorities state money supply targets which broadly correspond to the inflation rate plus the rate of growth of output which they are aiming at. The presumption is that the level of output and the rate of inflation are always and everywhere a monetary phenomenon.

In Nigeria, monetary policy over the years was aimed at restricting the rate of monetary expansion in support of measures aimed at containing inflation, and expanding money supply in pursuit of increases in output. It is widely believed that a tight monetary policy impedes economic growth while an easy monetary policy helps accelerate growth. On the other hand, a rapid monetary expansion, it is argued causes a high rate of inflation. Thus moderation in the rate of monetary expansion has been a main feature of Nigeria's growth strategy since the 1970s.

In 1980 for instance, the Government in a bid to

expand the level of economic activity, increased money supply by 48.6 per cent, compared to the 20.8 per cent increase in 1979. Rather than improving, the tempo of economic activity decelerated. The overall level of output which improved significantly in 1979 virtually stagnated in 1980 (CBN, Annual Report, 1980). In 1981, the annual average rate of inflation measured by the composite consumer price index (C.P.I.), rose by 30.8 per cent compared to a rise of 9.9 per cent in 1980, when actually the level of money supply slowed down considerably in 1981. Also in 1982, money supply increased phenomenally but the GNP fell when compared to 1981. Similarly in 1984, money supply increased by 8.2 per cent compared to 1983 but the estimated GNP which although declined by 6.4 per cent in 1983 fell further by 0.6 per cent in 1984. In 1989, inflation escalated into double-digits with the C.P.I. averaging 47 per cent, the tight money policy notwithstanding.

The bizarre behaviour of the GNP and consumer price index (C.P.I.) in no way corresponded to the behaviour of

money supply in Nigeria. The familiar relationship that had characterized prior experience simply disappeared, leading to chronic instabilities in the money-GNP, and money-C.P.I relationships.

It therefore follows, that the quantitative relationship connecting GNP and price movements to the growth of money stock in Nigeria which has been the chief focus of monetary policy over the years was indeed absurd. Thus experience ought to be teaching us that economists can no longer focus exclusively on money supply as a panacea for changes in output and the price level. The reverse causation which can also exist is often ignored.

1.1 STATEMENT OF PROBLEM

There is a long tradition of association between money supply and GNP, and between money supply and the price level. Economists who emphasize this connection uphold a modern version of the quantity theory of money, the monetarism. Leading monetarists like Milton Friedman have claimed that changes in money supply are the principal cause of changes in economic activity. In support of this position, Friedman and his associates have marshalled

an imposing volume of evidence of several kinds explaining the money—economic activity causal nexus. In a series of articles using the U.S. and other developed economies as their base, Friedman and Schwartz (1963), Friedman and Miseleman (1963) claim that increases in money supply lead to increases in output and prices. They believe that money does matter and matters very much, and that changes in the quantity of money have important and broadly predictable economic effects.

Consequently, developing countries have adopted this orthodox monetarist approach and have consistently relied on manipulations of money supply to achieve economic stability and growth. Thus what occupied most of the literature in these developing countries was the length of the lag in the effect of monetary policy, and its comparison with fiscal policy. Little attention was directed towards finding out whether the role of money in a developed economy such as the U.S., is essentially the same as in less developed ones.

In Nigeria, monetary policy circulars specified the permissible growth rates of money supply aimed at achiev-

ing economic growth and stability. There have also been various loan schemes aimed at stimulating productivity by providing high powered money. The Agricultural Credit Guarantee Scheme, Development and Co-operative Banks Credit Scheme are useful examples. Their objectives have remained largely unachieved. The establishment of the Peoples' Bank, the Graduate Loan Scheme, the National Economic Reconstruction Fund, the African Development Bank (ADB), Export Stimulation Loan Scheme, inter alia, are indicative of the newly inspired vision of accelerated growth through increases in money supply. Money supply is also seen as one of the crucial factors governing the price level.

Considering the peculiar characteristics and the structure of the economy of less developed countries vis-a-vis the developed countries, accepting that changes in money supply causes changes in GNP or price level may be slightly deceptive. Most developing economies have a small modern sector, no-capital goods sector and a high marginal propensity to import. Ajayi (1978) believes that given the high marginal propensity to import in

Nigeria and the limitation of productive investment, expansion of money supply or credit may not necessarily result in substantial increases in domestic production. All that may happen is that the increases may be used to procure foreign goods and services. Moreover, granted the poor investment sensitivity to money supply in Nigeria, increases in money supply may not lead to increases in output. Onoh (1982) contends that the monetarist assertion has very little application in the African economies which cannot be described by any standard as being fully employed. He asserts that African economies still depend to a large extent on advanced countries for most of their imports of consumer and capital goods. Thus the domestic prices of these goods are influenced not only by the domestic increase in money supply but by variations in the variables of the industrialized economies from where they were imported.

Furthermore, recent theoretical work in monetary economics has gone into the open economy case suggesting that the role of money may be substantially different in such economies. Jonson (1976) argues that the monetary

approach to the Balance of Payment presents powerful reason why reverse causation is likely to be particularly important in small open economies. He suggests that any influence of domestic monetary disturbance on prices or income will be a strictly disequilibrium phenomenon. Benneth and Barth (1974) believe that the role of money in an open economy is likely to be different because the use of monetary policy for domestic purposes is circumscribed by interest-sensitive international capital flows. Nigeria is neither a closed economy as the U.S., nor as open as that of Canada but as Ajayi (1978) puts it, "it is somewhere in between the two" in terms of the ratio of exports to total domestic output. Nwankwo (1985) has provided evidence to show that the openness of the Nigerian economy has grown phenomenally as shown by the import-GDP, export-GDP and import-plus-export-GDP ratios.

An implication is that the form and direction of causality relationship do depend on institutional context and the monetarist results in the U.S. do not have a general validity in all economies. This has necessitated

an interest in this research in Nigeria.

In addition, developing countries have continuously misconstrued the finding of a statistical association between money supply and economic activity indicators to mean that money supply causes changes in economic activity. Thus evidence of such linear associations in these countries has been interpreted as money causing changes in economic activity. However, it is now widely recognised that no degree of positive association between money and measures of economic activity can prove that variation in money supply causes variation in, say, GNP. Money might equally react passively and reliably to fluctuations in economic activity (Cargil (1979), Denburg (1960), Pierce and Haugh (1977)). Davidson and Wientrub (1973) have argued that the identification of correlation with causation violates careful econometric usage and evades the profound cognitive issues. Apparently, this confusion is perpetuated by students of the monetarist school.

More sophisticated auto regression methods capable of detecting causality should be employed to generate conclusions devoid of skepticism. Both Granger (1969) and Sims (1972) have described the statistical theory that can be used to construct tests of causal pattern

within a bivariate system. Sims (1972) employed this method to determine the causal link between stock of money and GNP using quarterly data for the U.S. economy. The same method has been applied to other countries to produce results that are sufficiently varied.

Thus the focal problem this research addresses itself, is to investigate the causality direction of influence between money supply and GNP, and between money supply and the price level in Nigeria. In a bid to achieve this objective, the relationship between money supply and these macroeconomic indicators will be explicitly and empirically examined. The basic questions to be answered are:

1. Are fluctuations in these macroeconomic indicators the cause or the result of fluctuations in money supply? Put differently, is the direction of influence from money supply to these indicators or from these macroeconomic indicators to money supply?
2. Is causation bi-directional implying reciprocal causation?

1.2 OBJECTIVES OF THE STUDY

The study will be carried out with the following objectives in mind:

i. To empirically find out the direction of causality between money supply and GNP in Nigeria.

ii. To empirically find out the direction of causality between money supply and price level in Nigeria.

1.3 IMPORTANCE OF THE STUDY

This research is important for several reasons. Firstly, it intends to empirically validate or otherwise invalidate the apriori assumption regarding the existence of causal relationship between money supply and GNP, and between money supply and consumer price index (C.P.I.) in Nigeria. More importantly, testing the two hypotheses that there is a consistent unidirectional pattern of causation which runs from the stock of money to both GNP and C.P.I. can provide empirical insight into the monetarist view of the role of money in the economy, and in particular, Friedmans view of the mone-

tary mechanism. This will have important implications for the conduct of monetary policy in Nigeria.

The establishment of a causal pattern has other far reaching implications for economic growth and other policy strategies. If there is a definite unidirectional causality from money supply to GNP, then output and the standard of living can be raised by manipulating money supply. This may provide support for Government's recent introduction of the Peoples Bank aimed at extending high powered money to the grassroot. Also, if causality is from money supply to consumer price index in Nigeria, then inflationary pressures could be curbed by curtailing the rate of monetary expansion. This also supports the early quantity theorist doctrine, that a change in the quantity of money produces a proportionate change in the general price level. It may equally explain the recent measures taken by the Central Bank of Nigeria to mop up excess liquidity in the economy in order to reduce the growth rate of inflation.

If the causative process is of the opposite direction, for example, from GNP to money supply, it will imply

that the only concern of the federal authorities should be to meet the needs of trade. This therefore puts to question, the role of money and the efficacy of monetary policy. Similarly, if the causative process is from consumer price index to money supply, then inflationary trend in Nigeria should be related to other factors beyond the money supply process.

On the other hand, if causality is actually bi-directional implying reciprocal causation, then the Government could adopt any of the options to stimulate growth and to ensure stability. However, if there is no definite causality between money supply and GNP, and between money supply and C.P.I., then alternative policy instruments rather than money supply per se should be adopted to enhance economic stability and growth.

1.4 LIMITATIONS AND PERIOD OF THE STUDY

The relationship between money supply, prices and the GNP are investigated using quarterly and annual data. In constructing the quarterly model, data constraints make it impossible to go beyond money supply and the price variables. However, for the annual models it is

possible to include those variables which are not available on a quarterly basis.

The study covers the eighteen year period 1970-1988.

1.5 ORGANIZATION OF THE RESEARCH

Chapter one treats the statement of problem and the importance of the study. It also highlights the limitations of the study and states the period covered by the study. A critical survey of literature which is divided between the theoretical and empirical review is taken in chapter two. A brief study of the role of money supply in Nigeria is discussed and also the hypotheses guiding the study are all presented in chapter two. Chapter three presents the theoretical framework. Chapter four outlines the methodology adopted in the research. Alternative methods of carrying out the research are also examined in this chapter. The fifth chapter presents the regression results and the various statistical tests of significance. The working hypotheses are also evaluated. Chapter six and seven discuss both the implications of the result and the summary of the study respectively.

CHAPTER TWO

LITERATURE REVIEW

The role that money plays in economic activity has always attracted the attention of economists. The longest held theory of this role is the quantity theory, of which there have been many versions, but all sharing an insistence on the importance of money supply and most stressing a causal relationship running from the quantity of money to the level of prices. According to the early quantity theorists, the principal thrust of a change in the quantity of money is to cause a proportionate change in the level of prices. This assertion dominated earlier economic thinking.

The great depression of the 1930s, however, radically changed economic attitudes. During that time, there was no stable relationship between changes in the money stock and changes in the price level. In the United States, the failure of the federal reserve system to stem the depression was widely interpreted to mean that monetary factors were not critical and the real factors were the key to economic stabilization. The emergence of the Keynesian model ushered in a shift away from monetary f a c t o r s as c a u s e and explana-

tions of changes in economic activity and a shift towards non-monetary factors such as changes in consumption and investment as primary forces determining economic activity. Consequently, monetary policy was dragged down from the position of honour that it occupied as a result of Keynes criticisms. It lost all its prestige and had been given up as an economic policy instrument, since it was increasingly argued that monetary policy was useless in bringing about economic growth and price stability. The new belief then, was that, "money did not matter", and its only role was the minor one of keeping interest rates low, in order to hold down interest payments in the government budget, and may be stimulate investment a bit to assist government spending in maintaining a high level of aggregate demand (Friedman, 1969:96).

However, by the mid-1950s a reaction set in. Supporters of monetary policy pleaded that it was unwise to regard monetary policy as generally ineffective on the basis of the analysis of the thirties. Those who still believed in the efficacy of monetary policy undertook serious researches to test the effectiveness of monetary

policy. These research studies clearly show that "money does matter". In the revival of monetary theory, the contributions of Milton Friedman, his collaborators, students and other followers of the chicago school have been very important. Such questions as, how important is money supply as a determinant of the level of output and prices have been addressed. This formed the new monetarist thinking, called monetarism. Monetarism emphasizes the importance of the behaviour of the money stock in determining the rate of inflation and the behaviour of GNP. It insists that changes in the growth rate of money, accelerations and declerations, account for changes in economic activity.

Two important studies that have had an impact by providing evidence on the importance of money and monetary policy are those by Friedman and Schwartz (1963) and, Friedman and Meiselman (1963). These two studies stimulated a lot of interest in the role of money in an economy. Thus, they are discussed below.

The Friedman-Schwartz Study

As part of their massive study of the role of money

in the United States economy, from 1876-1960, Friedman and Schwartz examined the statistical relationship between changes in money supply and a general measure of economic activity. The measures of economic activity used were the turning points in the general business activity. Friedman and Schwartz compared the growth rate of money supply to the change in economic activity represented by the business cycle turning points and reached the following conclusions:

1. The amplitude of changes in the money supply were closely associated with the magnitude of the business cycle. Minor fluctuations in economic activity were associated with minor fluctuations in the growth rate of money supply whereas major changes in economic activity were associated with major changes in the growth of money.
2. Changes in money supply preceded the change in business for all the major economic fluctuations. The average lead of the change in money, or as commonly stated, the average

lag in the effect of change in money was 12 months for increases in the growth of money and 16 months for decreases in the growth of money.

3. Even though a consistent lag of changes in money was found, the individual lags fluctuated widely around the average values.
4. Even though the study covered a period of over 9 decades, Friedman and Schwartz concluded that the relation between money stock and business activity had remained unchanged.

In summary, Friedman and Schwartz concluded that, not only is there a close relationship between money stock and measures of economic activity, but that the important influence is from money supply to economic activity and not the other way round.

The Friedman-Meiselman Study

This study was designed to set up a simple test of the monetarist and Keynesian views by expressing both in a general framework. The monetarist model was based

on the quantity theory equation using income rather than total transactions.

$$YP = vm \quad \ldots\ldots\ldots (1)$$

This expression was then transformed into a linear form

$$YP = a + vm \quad \ldots\ldots\ldots (2)$$

The monetarist view requires v (demand for money function) to be stable overtime. Expression (2) states that the level of income depends on the money supply and since we wish to see whether changes in the money supply lead to changes in the level of economic activity, expression (2) is transformed into differnces with a new constant term, a^1 added,

$$\Delta YP = a^1 + v^1 m \quad \ldots (3)$$

The Keynesian view was expressed by the following linear functions relating income to autonomous changes in spending.

$$YP = b + kA \quad \ldots\ldots\ldots (4)$$

Friedman and Meiselman expressed the monetarist and Keynesian views in a simple one equation model, to subject each to empirical testing using data covering 1860-1958 in the United States. They found that changes

in income could almost be entirely accounted for by changes in the money supply.

The Friedman-Schwartz, and Friedman-Meiselman studies precipitated great debate and research into the economics profession. Criticisms came from such writers as Minsky (1963), Okun (1963), Crockett (1973), Wonacott (1984), while other writers as Tobin (1970), Geweke (1986), Mansfield (1983) carried out researches to verify the two studies. Minsky (1963) argues that the Friedman-Schwartz study failed to make a convincing case for the strong view that monetary changes fully explain observed business cycles. Similarly, most Keynesians believe that the lag which Friedman and Schwartz had discovered was largely the result of comparing the level of output with the rate of growth of money supply (Crockett, 1973:61). Thus they assert that it is a natural phenomena of any cyclical series that its rate of growth reaches a peak before its absolute value. Once it was compared with the level of money stock, the lag more or less disappears. The Keynesians were able to demonstrate that the remaining connection between

money and national income could be the result of not money influencing economic activity but of expanding economic activity generating a need for additional money balances which were created.

Wonnacott (1984) observes that the close relationship between money and nominal GNP which Friedman and Meiselman obtain reflects effects of both changes in the money stock on aggregate demand and changes in the aggregate demand on money stock. Tobin (1970) accepts Friedman's view of money causing business cycles but points out the dangers of accepting timing evidence as empirical proof of propositions about causations. Geweke (1986) carried out tests for structural neutrality of the growth rate in money with respect to the growth rate of output. Money is neutral when changes in the money stock lead only to changes in the price level, with no real variables (output, employment and interest rates) changing (Dornbusch and Fischer, 1984:369). He used the annual time series of Friedman and Schwartz. The results show structural super neutrality of money with respect to output measures in all periods of the United States

economic history.

The analogy that can be drawn so far is that the monetarist conclusions of Friedman and Schwartz and Friedman and Meiselman in the United States are still controversial. Thus there have been different explanations on the direction of causation between money supply and GNP, and between money supply and the price level. Sayers (1962) contends that money supply mainly determined by bank advances starts to increase only after recovery from a depression has set in, and similarly money supply begins to contract only after a recession has begun. Accordingly, he thinks the money supply is passive in the trade cycle.

Coghlan (1981), Lee and Jao (1982) assert that there is no single unidirectional causality, rather causality runs in both directions. Thus there is a feedback or a bidirectional causation between money supply and economic activity. They interact in mutual causation and effect. The argument of Furness (1975) is quite remarkable. The fact that changes in money supply frequently precede changes in GNP does not prove that money plays the causa-

tive role. The truth he believes is that there is often some third factor which causes changes in both. Mansfield (1983) opines that if the economy is at considerably less than full employment, increases in money supply would be expected to increase real NNP while decreases in money supply would be expected to reduce real NNP. However, once full employment is approached, increases in money supply results in more and more increases in the price level as distinct from increases in real GNP.

A peculiar method of causation distinct from both the monetarists and other skeptics was developed by Chisterinin (1964). He sees an adequate money supply as a condition of a high level of economic activity. Thus he believes that any attempt to reduce money supply must result in unemployed resources and a reduction in national income. A reduction in money supply would reduce total expenditures, inventories would grow, unemployment would increase and output falls. These developments breed pessimism and prompt an increased demand for liquidity thus aggravating the fall in aggregate demand and reducing the velocity of money supply. The falling price level

would cause undue hardship among existing debtor groups and would make potential debtor groups reluctant to borrow. Thus wage earners would suffer immediately from unemployment and lack of income, the nation would suffer from reduction in output. The reduction in income itself reduces aggregate demand causing still further declines in income. This was however in respect of the Swedish economy.

It seems apparent that there is no general theoretical consensus on both the causality method and the direction of influence between changes in money stock and changes in the price level and GNP in all economies. Thus the direction of influence in developing economies like that of Nigeria may be different from those of the highly developed economies.

2.1 THE ROLE OF MONEY SUPPLY IN THE NIGERIAN ECONOMY

There have been in recent times a debate among economists as to the role of money supply in the Nigerian economy. While such writers as Ndekwu (1983), Furness (1975), Onoh (1982) argue that money supply does not have any remarkable effect on the level of economic activity,

the other side holds that the effect of money supply on the level of economic activity is highly significant (Okigbo (1981), Akinnifesi and Phillips (1978), Osakwe (1983), Oke and Nwade (1977)).

Ndekwu (1983) contends that there is no direct connection between a change in price level and a change in money supply in Nigeria. The connection between the two variables is made up by a change in the demand for money. In other words, an increase in the price level will increase the demand for money and thence the supply of money. Furness (1975) believes that a third factor such as Government deficit expenditure causes changes in money supply and GNP, but since it takes time for the GNP repercussions to be fully realized, whereas the monetary consequences are immediate, it is not surprising that increases in money frequently precede those in income. Onoh (1982) generalizes his view for all African economies which he believes are still far from being fully employed. Thus he argues that since African economies still depend to a large extent on advanced economies for their imports of consumer and capital goods, the domestic prices of

these goods are more influenced by variations in the variables of the industrialized economies from where they are imported. In contrast, Okigbo (1981) and Osakwe (1983) argue that inflation in Nigeria defined as persistent increase in the general price level results solely from a sustained expansion of money stock.

Nevertheless, the importance of money and its control in the nations general economic management has grown over the years and the responsibility of stabilizing the economy has fallen more on the nations Central Bank which has monetary policy as its main tool. Broadly, monetary policy is the management of the expansion and contraction of the volume of money in circulation for the specific purpose of achieving certain declared national objectives (Uzoaga, 1981:161).

The objectives of monetary policy in Nigeria have alternated between the following:

(a) The maintenance of a relative stability of domestic prices.

(b) The acceleration of the pace of economic growth.

(c) The maintenance of a healthy balance of payment position. We have to examine each of these policy objectives against the background of the role assigned to money supply.

Money Supply and the Stability of Domestic Prices

The proposition concerning monetary theory of the price level suggests that unless the stock of money changes, the general level of prices will not be influenced by changes in the rate of business investment, or by changes in Government spending or taxation (Fand, 1970:152). Consequently, inflation and deflation are to be seen as monetary phenomena and the money stock as the key policy variable for avoiding inflations and for preventing severe depressions. Thus in an attempt to control inflation in Nigeria and ensure a relative stability of domestic prices, Government policy has centered around the reduction of the volume of money in circulation. As a matter of fact, several studies seem to support this stance (Akinnifesi and Phillips (1978), Osakwe (1983), Okigbo (1981), Oke and Nwade (1977)).

Akinnifesi and Phillips observes that the effect of unprecedented high growth rate of the money stock in Nigeria has been inflationary, and that a way to curb the trend effectively is through a rational money supply process. Thus the immediate issue of interest is how the monetary authorities can effectively regulate the growth in the money stock so as to moderate the growth rate of domestic prices. Similarly, the analysis Osakwe (1983) draws is that a short-run policy designed to control inflation should take cognisance of the slow and cumulative impact of changes in money supply on the price level. Oke and Nwade (1977) warns that unless the growth rate of money supply is reduced to a level close to the growth rate of real output, the inflationary pressure would persist.

It is evident, that there is a general agreement that contraction in the volume of money supply could curb the inflationary trends, even though it has been realized that inflation in Nigeria is identified with factors beyond the ordinary money definition.

Money Supply and Economic Growth

A core objective of monetary policy in Nigeria is to ensure sustained economic growth. Economic growth refers to both quantitative and qualitative increases in the total quantity of goods and services produced in the economy annually. It implies a higher money income accompanied by a higher real income. In achieving this objective, money is seen as a means to an end and it is often argued that a tight money policy impedes economic growth, while an easy money policy accelerates growth. Increases in money supply are viewed to enhance the overall level of economic activity which gives rise to increases in domestic output. Thus monetary policy guidelines in Nigeria ensure that adequate credit is made available, especially to the priority sectors of the economy, in order to increase the supply of goods and services. Ajayi (1978), however, argues that given the high marginal propensity to import in Nigeria, and the limitation of productive investment, expansion of credit may not necessarily result in substantial increases in domestic production. All that may happen is that the

increases may be used to procure foreign goods and services.

If the argument of Ajayi is accepted, it therefore means that government policies of stimulating output by providing high-powered money may be self-defeating. Moreover, granted the poor investment sensitivity in Nigeria, such money distributing schemes like the Peoples Bank may not be worthwhile.

Money Supply and a Healthy Balance of Payments

The focus of monetary policy in Nigeria at times has been on the defence of the Balance of Payment position. In such times the "credit restraint policies" were adopted. Such restraints were assumed necessary since rapid monetary expansion was identified to be the cause of drain on foreign reserves, following increased demand for imports due to the increase in purchasing power. Viewed in this light, the balance of payments in Nigeria is then seen as a monetary phenomenon. The main idea being that the money supply process is used as a central theoretical relationship around which to organize thought concerning the balance of payment.

In support of this position, Dornsbuch and Fischer (1984) argue that it is obviously true that for any given balance of payment deficit, a sufficient contraction of the money stock will restore external balance. The reason, they believe, is that, monetary contraction by raising interest rates and reducing spending, generates a contraction in economic activity, a decline in income and therefore a decline in imports. Granted that the monetary approach to the balance of payments holds, one still doubts its applicability in African economies. Fleetwood (1962) opines that since African economies are all open economies and dependent upon exports and imports, the monetary approach to the balance of payments may be ineffective. Benneth and Barth (1974) equally believe that the role of money in open economies may be substantially different. Nigeria's economy is now identified as being open (Nwankwo (1985).

2.2 EMPIRICAL LITERATURE

A number of studies have investigated the empirical validity of the assumed causal relationship between money supply and GNP, and between money supply and the price

level. Such earlier studies by Oke and Nwade (1977), Driscoll (1981), Ajayi and Ojo (1981), Saxena and Srivastava (1969), Kwom and Shriber (1971), Rao (1970), Singh (1970), Okigbo (1981) were based on correlation analysis. Oke and Nwade (1977) fitted a simple regression equation of money supply to the price level. The regression equation $P = 1.21 + 0.063\ m_1$ was found to fit the data such that a ₦100 million increase in money supply will generate a 6.3 per cent increase in the price level. This was for the period 1973-1977 in Nigeria.

Similarly, Ajayi and Ojo (1981) studied the relationship between money supply and income expressed as $Y_t = \alpha_o + \beta_o M_{it}$. Using first difference values of the Equation, they found the money Coefficients to be significant at the 5 per cent level. The goodness of fit R^2 in all cases was indeed poor. They also carried out a regression of the form $P = f(M_t, M_{it-1}, M_{it-2} \ldots\ldots)$ to test the relationship between money and prices. In all the cases they tested, they found that only about 46 per cent of variation in prices is explained by variations in the money supply. The conclusion they drew is that infla-

tionary trends in Nigeria cannot be adequately explained by looking at the money supply alone. Driscoll (1981) carried out a linear regression of economic activity on current and lagged values of the monetary agregates. Using GDP as a proxy for economic activity, regressions of GDP on the monetary aggregates were run using quarterly data for South Africa. The result in terms of R^2 shows that changes in the monetary aggregates are good indicators of changes in economic activity.

Similar studies have been carried out in India (Saxena and Srivastava (1969), Singh (1970), Kwom and Shirber (1971)). Saxena and Srivastava studied the relationship between money supply, output and prices. They carried out a regression analysis of output on money supply and of prices on money supply. They find that money supply and output are significantly correlated with an R^2 of 0.76. This implies that an increase in output is closely linked with an increase in money supply. They also conclude that a rise in money supply causes a rise in prices. Singh (1970) using data from 1958/59 to 1966/67

regressed money supply on income to obtain an R^2 of 0.97, and also regressed income this year, (Y_t) on last year's money supply, (M_{t-1}) to obtain an R^2 of 0.97. Thus making it obvious that there is a one year lag in the supply equation, that is, increases in money supply in Yeart t, affects money income in Yeart t + 1.

The empirical findings reviewed have one major shortcoming. The fact that they are only correlation measures makes them unacceptable in determining causality relationships. Correlation measures are merely measures of Linear associations.

Granger (1969) developed two methods of investigating causality relationships among variables, the econometric model and the cross-spectral method.

The Cross-Spectral Method

The cross-spectral analysis is an application of fourier analysis to a discrete time series, for it attempts to explain the variance of a time series by decomposing the series into cyclical components and estimating the contribution of sinusoidal waves of differing frequencies to the total variance. It estimates the rela-

tionship between frequency components of one series and the same frequency components of another series. The coherence of cross-spectral analysis corresponds to the coefficient of determination, R^2, in regression analysis. Thus if the cyclical behaviours of the series are closely associated, the coherence of the series and the business cycle frequency should be significantly different from zero.

Benneth and Barth (1974), Backsdale et al (1975) employed the cross-spectral methods in testing the direction of influence between money supply and economic activity in the United States. The Benneth and Barth result suggests that fluctuations in economic activity cause fluctuations in money supply. Contrary to their findings, Backsdale et al (1975) using the same method reports that the direction of influence is mainly from money supply to economic activity measures. The differences in their findings have been attributed to the method used in computing their spectral estimates. While Backsdale et al employed parzen weights, Benneth and Barth used the Turkey weights.

The Econometric Method

If X causes Y, a regression of Y on past, current and future values of X should exhibit significant coefficients for past and current values but insignificant coefficients on future values. Again if X causes Y, a regression of X on past, current and future values of Y should exhibit significant coefficients on future values of Y and may or may not exhibit significant coefficients on present and past values.

In a multivariate case, the relationship between two series can be found, once the effect of a third or higher series has been taken into account.

Sims (1972) applied the econometric method in a bivariate model. Sims finds in the United States that causality runs entirely from money supply to GNP without feedback. This same method has been applied in some other developed countries (Goodhart et al (1973), Cassese and Lothian (1982), Sergant and Wallace (1973), Benneth and Barth (1974b), Sharpe and Miller (1975)).

In testing the causality relationship between money supply and the economic activity measures in the United

Kingdom, Goodhart et al (1973) finds that future lags of GDP on money are almost significant at the 5 per cent level whereas those of money on GDP are definitely non-significant, but are significant without future lags. This suggests an evidence of unidirectional causality from GDP to money supply and from money supply to GDP. The reason they advance for the different findings is that the United Kingdom is a relatively small open economy which during the test period maintained a regime of fixed exchange rates. Under such circumstances the private sector can more easily adjust their money holdings to their incomes by transfers of funds over exchanges, than in a virtually closed economy such as the U.S. (Goodhart et al, 1973:417).

In another study, Sergent and Wallace (1973) investigates the direction of causality between money and prices during periods of hyperinflation for certain European countries using an approach similar to Sims. The results they find show that inflation strongly influences subsequent rates of money creation, but the influence of money creation on subsequent rates of inflation is harder to

detect.

Similarly, Cassese and Lothian (1982) employed the Sims criterion in testing the causality between money and prices in Canada, France, Germany, Italy, Japan, Netherlands, United Kingdom and the United States. They found that except for France and Italy, a significant effect of lagged money on prices exists for at least the three periods. In most of the countries, they found a more pervasive influence than in either the French or Italian case. A significant effect of prices on money supply without feedback appeared in Italy and the U.K. in two instances with M_2. Benneth and Barth (1974b) finds that evidence of feedback exists between the stock of money and economic activity in Canada. Thus the monetarist view of the role of money cannot be established in Canada. However, Sharpe and Miller (1975) criticize the Benneth and Barth (1974b) conclusion. They suggest that the IMF time series data for Canadian money supply which Benneth and Barth use is inappropriate for the purposes of Sims test. They used the IMF end-of-quarter data to

generate figures for average money supply across each quarter. Thus applying the Sims test for GNP and the narrow definition of money supply (M_1), they conclude that there exist unidirectional causality from M_1 to GNP.

It therefore follows that the form and direction of causality relationship between money supply and economic activity measures depend on institutional context. Thus neither the Friedman's conclusion nor the Sims results in the U.S. is valid for the developing countries.

Ajayi (1983) recognises the fact that reverse causation may be possible under which monetary changes play the role of accommodation. In a test on the directional causality between money and prices in Nigeria, between 1961 and 1977, Ajayi reports that future values of prices have coefficients which are significant in explaining money supply, and also the future values coefficients of money supply are also significant in explaining price movements. The coefficients in the latter case are however much larger than in the first case. Thus using Sims interpretation of the F test, he concludes that causality is from money to prices.

This research intends to investigate the causality direction between money supply and GNP on the one hand, and the direction of causation between money and prices on the other hand. We shall employ both definitions of money supply in the analysis instead of only M_1 as Ajayi did.

2.3 LIMITATION OF PREVIOUS STUDIES

Most of the studies reviewed have in one way or the other, made useful contributions to the understanding of the causal direction of influence between money supply and economic activity indicators in Nigeria. Nevertheless, some of the earlier studies were not based on sophisticated and rigorous tests.

Imputing causality by interpreting the fluctuations in the time series as Friedman and Schwartz (1963) did suffers crucially from the overlooking of various anticipations which can induce a deceptive statistical lead of money supply series over the GNP. Moreover, identifying correlation as causation as most of the authors did may be misleading. Variables may be correlated yet not causally related. The study by Ajayi (1983) is commend-

able, but it is necessary to take a broad definition of money (M_2) rather than only M_1 as Ajayi did. This is moreso since national income has been identified to be more related with money defined as M_2 than when otherwise.

2.4 STATEMENT OF HYPOTHESES

The research is guided by the following hypotheses:

1. Causality is unidirectional from money supply to GNP.
2. Causality is unidirectional from money supply to consumer price index.
3. There is reverse unidirectional causation from consumer price index to money supply.
4. There is a reverse unidirectional causation from GNP to money supply.
5. There is a mutual or bi-directional causation between money and GNP, and between money and consumer price index.

CHAPTER THREE

THEORETICAL FRAMEWORK

Every empirical study rests on a theoretical framework, on a set of tentative hypotheses that the evidence is designed to test or to adumbrate.

The framework in this analysis is the 'Quantity theory of money' - a theory that has taken different forms and traces back to the very beginning of systematic thinking about economic matters. It has probably been tested with quantitative data more extensively than any other set of propositions in formal economics. Nonetheless, the quantity theory has been a continual bone of contention.

Alternative theories relevant to the study, and which will also be examined include the Keynesian theory, the monetarist theory and the portfolio approach.

3.1 THE BASIC THEORIES

(I) The Quantity Theory

One of the oldest surviving economic doctrines is the quantity theory of money, which in its simplest and crudest form states that changes in the general level of

commodity prices are determined primarily by changes in the quantity of money.

In the earlier versions of the doctrine, although a positive relationship between the aggregate money supply and the general price level was established so that an increase in the former led to a rise in the latter and vice versa, the version did not assert that this positive relationship between money supply and the price level was that of proportionality. The early quantity theorists were aware of the possibility of increases in the level of aggregate output over time due to technological improvements. They also realized that the velocity of money would change in some dependable manner in response to any given change in the quantity of money in circulation (MV) such that an increase in the aggregate money supply will cause the general price level to rise.

The quantity theory has however been reformulated. Essentially the quantity theory is a hypothesis about the main cause of changes in the value or purchasing power of money. The theory now goes beyond the bare contention that money governs prices, and includes a set of proposi-

tions or postulates that supports the contention. The postulates includes (1) The proportionality of money (M) and prices (P), (2) The causal role of money in monetary transmission mechanisms and (3) The neutrality of money.

The Proportionality Postulate

This states that prices will vary in exact proportion to changes in the Quantity of money. In otherwords, a given percentage change in the stock of money will result in an identical percentage change in commodity prices. Associated with the strict classical version of the Quantity theory, this proposition follows from the assumption that people want to hold for transaction purposes a constant quantity of real cash balances $\frac{M}{P}$, at the economys full capacity level of real output. Because the cashholders look to the purchasing power rather than to the mere money value of their cash balances, the price level must vary in direct proportion to the nominal money supply to maintain the real balances intact.

The proportionality postulate implies that the demand for real cash balances and its counterpart, the circulation velocity are completely stable. It is only if the

demand for real balances remains unchanged will the proportionality relationship hold. It follows that the strict version of the quantity theory must assume complete stability of the demand for money if it is to predict that money and prices will show equiproportionate variations.

The Causal Role of Money

This proposition states that the direction of causation or channel of influence runs from money to prices, that is, monetary changes precede and cause price level changes. In this cause and effect relationship, money is seen as the active variable and the price level as the passive or dependent variable.

The lead-lag, cause-effect relationship between money and prices implies that a change in money initially creates a disequilibrium between money and prices. This disequilibrium then invokes forces that causes prices to change. Prices continue to change until proportionality is restored and equilibrium is eliminated.

For such an adjustment process to occur, there must be some linkage through which monetary impulses are

transmitted to the price level. Two main transmission mechanisms have been identified, namely the (1) Direct expenditure and (2) The Indirect Interest rate mechanisms.

The direct expenditure mechanism refers to the process by which the impact of monetary changes is channelled to the price level via a prior effect on the demand for goods. The key link in this process is the relationship between the rate of spending on the one hand and the discrepancy between actual and desired real balances on the other. Variations in the rate of spending are seen as the means by which actual real cash balances are adjusted to the level that people desire to hold. From a position of long-run equilibrium with the supply of money equalling the demand for money, let the money supply rise. In the new situation, actual real balances, $\frac{M}{P}$, held by individuals exceed their desired level that is, the position maintained before equilibrium was disturbed. Individuals react to this excess holding of money balances by attempting to run them down by purchasing goods, consumer durables and financial assets. However,

someone must hold the increased money balances and so it is not possible for everyone, simultaneously to spend their excess holdings. In addition, output is fixed in the short run and the attempt to purchase more goods, durables and assets in aggregate cannot succeed. As a result, prices rise until the new higher level of nominal balances is equivalent to the equilibrium level of real balances. Once prices have risen sufficiently so that desired and real balances are equal, the process is ended and equilibrium restored. Prices have risen by the same proportion as the money supply.

The Indirect method refers to the process by which a monetary change influences spending and prices indirectly via its prior effect on the interest rates. This was suggested by Henry Thorton and later used by Wicksell. Thorton argues that while the direct mechanism is appropriate for a simple commodity money, a more sophisticated system in which commercial banks exist introduces the rate of interest as a key part of the transmission mechanism. Thus, in this process, a monetary injection first causes the rate of interest to fall thereby stimulating

business investment spending and thus exerting upward pressure on prices. More precisely the indirect method relies on two links (1) The creation of a monetary-induced gap between the expected rate of profit on capital investment and the market rate of interest and (2) an investment response to this gap. Both the direct and indirect mechanisms provide the two main channels through which the dynamic price adjustment process works.

The Neutrality Postulate

This proposition states that monetary changes exert no influence on real economic variables, example, total output, employment, and the product-mix. These variables, it is argued, are determined by basic non-monetary conditions such as tastes, technology, resource endowments, etc. As the quantity of money in no way alters these fundamental conclusions, it follows that monetary changes are neutral in their long-run effects on real variables.

Quantity Equations

The quantity theory of money has been stated in different forms of the equation of exchange. The two most well-known forms of the quantity equation are the cash

transactions equation of exchange and the cash balances equation of exchange.

(A) The Transactions Equation

This quantity equation was propounded by Irving Fisher and is stated as follows:

$$MV = PT \quad \ldots\ldots\ldots \quad (1)$$

$$\text{or} \quad MV + M^1V^1 = PT \quad \ldots\ldots \quad (2)$$

In this version, the elementary event is a transaction, an exchange in which one economic actor transfers to another economic actor goods or services or securities and receives a transfer of money in return. The right hand side of the Equations corresponds to the transfer of goods, services and securities; the left hand side, to the matching transfer of money (Friedman, 1970:196).

Each transfer of goods, services or securities is regarded as the product of price and Quantity. The right hand side of Equations (1) and (2) is the aggregate of such payments during some interval with P, a suitably chosen average of the prices and T, a suitably chosen aggregate of the quantities during that interval, so that PT is the total nominal value of the payments during the

interval in question.

Money (M) in the right hand side is treated as a stock. The weighted Average of these numbers of turnover weighted by the number of currency that turned over that number of times is the conceptual Equivalent of V. Thus V and V^1 reflect communitys spending habit. According to Fisher, M cannot change autonomously since there is a stable relationship between the primary money, the bank reserves, and the volume of bank deposits. Under these assumptions, Fisher concluded that changes in the quantity of money were the exclusive cause of changes in the general price level.

(B) Income Form of the Quantity Equation

The more recent developments of national or social accounting has stressed income transactions rather than gross transactions and has explicitly and satisfactorily dealt with the conceptual and statistical problems of distinguishing between changes in prices and changes in quantities. As a result the quantity equation has more recently tended to be expressed in terms of income rather than of transactions. Let Y = nominal national income,

P = the price index in estimating national income at constant prices and, Y_y = national income at constant prices so that, $Y = Py$ . . . . . (3).

Let M represent the stock of money, but define V as the average number of times per unit of time that the money stock is used in making income transactions. We can then write the quantity Equation in income form as,

$$MV = Py \quad \ldots\ldots\ldots \quad (4)$$

or if it is desired to distinguish currency from deposit transactions as

$$MV + M^1V^1 = Py \quad \ldots \quad (5)$$

In the transaction version of the Quantity Equation, each intermediate transaction - that is, purchase by one enterprise from another - is included in the total value of the transaction. In the income version, only the net value added by each of these transactions is included.

Clearly, the transactions and income versions of the quantity theory involve different conceptions of the role of money (Friedman, 1970:201). For the transactions version, the most important thing about money is that it is transferred. For the income version, the most important

thing is that it is held.

(C) Cambridge Cash-Balances Approach

The main propelling force behind developing the cash balances approach was to integrate the theory of money with the theory of value.

According to Alfred Marshal who is greatly associated with this approach people in a country hold in the form of currency or 'ready purchasing power' a certain fraction of their property or wealth. How much money will people want to hold for this purpose. It has generally been supposed that the amount bears relation to income, on the assumption that this affects the volume of potential purchases for which the individual or enterprise wishes to hold, and the amount of their property. Marshal expressed it in terms of the following Equation:

$$M = KY + K^1A \quad \ldots\ldots\ldots\ldots (6)$$

where K is the fraction of their money income and K^1 is the fraction of their total assets expressed in terms of money value which people find it worthwhile to keep in the form of currency. Consequently, the demand for money was functionally related only to the level of money

income reducing the above Equation to the simple Equation

$$M = KY \quad \ldots\ldots\ldots\ldots (7)$$

Since the total annual money income Y, of the community is simply the product of the aggregate real income or output, which we may designate as O and price level P, the above Equation may also be written as,

$$M = KPO \quad \ldots\ldots\ldots\ldots (8)$$

The Equation has been variously written as M = KPY or as M = KPY or as M = KPT. However, all these are identical since Y = y = T = aggregate real income or output and P = P = price level (Vaish, 1977:56).

Thus an increase in the supply of legal tender ought always, since the elasticity of demand for legal tender is equal to unity, to raise price in the proportion in which the supply is increased.

(II) The Monetarist Theory

The traditional quantity theory of money was discarded by economists following the publication in 1936 of Keynes "General Theory of Employment, Interest and Money". Throughout the 1930s and 1940s the University of Chicago continued to be one of the few academic centres

at which the quantity theory was still taught. Economists at Chicago developed a more subtle and relevant version, one in which the quantity theory was connected to and integrated with the general price theory and become a flexible and sensitive tool for integrating movements in aggregate economic activity. The foremost exponent among the Chicago economists is Milton Friedman. Their theoretical approach insisted that money does matter. Owing to their insistence on money as unique, their approach has been dubbed the "monetarist approach".

Monetarists assume that either the level of transactions (T) or the price level (P) is fixed, so that any impulse from the left hand side of Equation MV = PT, is reflected in movements in both prices and transactions. As a result, money is non-neutral. It does influence output as well as prices, although output may have a tendency to move around its natural level and so be stable in long run equilibrium.

In the modern quantity theory of money, money is regarded as an asset among many other assets that are held because of the services they provide. Friedman

regarded the amount of real cash balance $(\frac{M}{P})$ as a commodity which is demanded because it yields services to the person who holds it. Thus money is an asset or capital good.

Friedman gave the demand function for money for an individual wealth holder as

$$M = F(Y,P,rb,re, \frac{I \cdot dp}{P \cdot d_t}, W)$$

In the above Equation, M is the total stock of money demand. Y is the permanent income, P represents the price level, rb and re are the yields on bonds and equities respectively while $\frac{1}{P} \cdot \frac{dp}{dt}$ is the expected rate of change of prices of good. W is for the ratio of human to non-human wealth.

According to Friedman, a change in the supply of money will lead to a proportionate change in the price level. Producers will respond to the increasing price level and demand by raising the rate of production of goods and services. Thus output will increase and level of income will rise.

However, the various channels of influence are specified, monetary forces will always have a crucial,

though complex role in the determination of nominal income in the monetarist thought. Friedman (1970) has said that a change in the rate of monetary growth will be followed by a change in the level of output, about 6 to 9 months later and the rate of inflation 6 to 7 months after that. The length of these lags is uncertain and of course, they vary considerably across countries and time periods, reflecting the time involved for the various transmission mechanisms to operate.

Friedman's view is based on part of his careful studies in which he was able to relate the booms and recessions of U.S. economic history to the behaviour of money stock. In general it appeared that an increase of the growth rate of money produced booms and inflation and decreases in the money stock produced recessions and sometimes deflations.

(III) The Keynesian Approach

This approach explains an alternative mechanism of the causal role of money in economic activity. The analysis of the role of money in the Keynesian system should begin with the quantity theory equation itself.

The Keynesian attack on the assumption made in the classical theory was severe. Firstly, real world experience showed that full employment was not the natural equilibrium state of an economic system; T was not fixed. In addition, Keynes noted the relative inflexibility of prices (P) particularly in the downward direction. Any monetary impulse from the left hand side of the Equation (MV) will change T primarily and will affect P should the special case of full employment exist. This analysis rejects the classical results of the neutrality of money and the proportionality of changes in money and prices.

Keynes rejected the naive direct mechanism of the classical school and even doubting the simplicity and potency of the classical link through interest rates. The basic assumption of Keynesian analysis is the close substitutability between money and other financial assets such as treasury bills, or other short-term papers. A small rise in the rate of interest on such assets, would cause investors to move out of them into money. The elasticity of demand for money with respect to interest

rates on liquid assets was therefore high.

The Keynesian transmission mechanism rejects any direct effects on income or wealth implicit in certain versions of the quantity theory. Keynes said that an increase in the quantity of money, would have no effect whatsoever on prices, as long as there is unemployment, and that employment would increase in exact proportion to any increase in effective demand brought about by the increase in the quantity of money. Keynes reformulated quantity theory of money emphasised that increases in the quantity of money will cause prices to rise when the level of full employment is reached and not before then. Thus money only affects the economy through substitution among financial or real assets dependent on the interest rate movements generated by the monetary change.

To Keynes, an increase in the quantity of money will first register an impact on the rate of interest which will tend to fall. With the marginal efficiency of capital (MEC) given a fall in the rate of interest will tend to increase the volume of investment. Working

through the multiplier effect, the increased investment will raise effective demand, thereby increasing income, output and employment. The conclusion that emerges from Keynes analysis is that a monetary expansion only affects the level of income and economic activity indirectly.

(IV) The Portfolio Balance Approach

In the portfolio approach, interest rates are used to explain the demand for money and other substitutes. The interest rates are also directly and primarily affected by a change in the quantity of money supply. A change in the quantity of money will lead to excessive holding of money, in relation to other forms of wealth. The excess balances will be exchanged for other substitutable assets. The prices of the money substitutable assets will rise in the process causing a fall in interest rates. The individual as well as the community's composition of assets will be affected. Consumption expenditures will also be affected. This fall in interest rates also affects investment decisions. Thus a decline in interest rates of say, financial assets will cause the public to decrease its holdings of them while increasing

the demand for, for example real capital. In the process, a rise in the prices of real capital goods will occur and this will lead to a fall in their rate of return.

As is usually the case, the higher price of capital goods will cause an increase in their production since it is now profitable. Consumption and investment expenditures will be stimulated and both will work through the multiplier and lead to an increase in income level.

CHAPTER FOUR

METHODOLOGY

The methodology adopted in this research is mainly econometric. This is understandable since econometric models are best suitable for testing the specific hypothesis about the nature of any economic relationship. The models are specified as follows:

4.1 THE BASIC MODELS

Apart from the Sims test which is employed in this research, there are other available alternative econometric methods. These methods are essentially designed to detect the existence of leads and lags between time series. They are discussed below.

(a) The Granger Test

The Granger (1969) procedures apply to stationary time series with zero means and relate linearly one series (X_t) to another (Y_t). The power cross spectrum Cr (W), in the bivariate case is first obtained and the coherence and phase functions are then computed. Cr (W) can be decomposed into the sum of causality components (example, $X_{to}Y$ and $Y_{to}X$). In the multivariate case, the relation-

ship between two series can be found, once the effect of a third or higher series has been taken into account. When causality exists, the causality coherence measures its strength. Consider the general model of causality involving X_t and Y_t,

$$X_t + b_o Y_t = \sum_{j=1}^{m} a_J X_{t-J} + \sum_{j=1}^{m} b_J Y_{t-J} + \varepsilon_t \quad \ldots\ldots (1)$$

$$Y_t + C_o X_t = \sum_{J=1}^{m} C_J X_{t-J} + \sum_{J=1}^{m} d_J Y_{t-J} + U_t \quad \ldots\ldots (2)$$

The disturbances ε_t and U_t are uncorrelated independent series with zero means. The model (1) and (2) constitutes a theoretical model of instantaneous causality. It reduces to a simple causal model when $b_o = C_o = 0$ (Granger 1969:42).

Y_t is said to cause X_t ($Y_t \longrightarrow X_t$) if $b_o = 0$, and X_t is said to cause Y_t ($X_t \longrightarrow Y_t$) if $C_o = 0$.

If both the above conditions occur, i.e. $Y_t \longrightarrow X_t$ and $X_t \longrightarrow Y_t$, feedback is said to take place.

In summary, the Granger (1969) version of causality is, variable X causes variable Y if the current innovations in Y can be better predicted from the past innovations of X and Y together than from past innovations of

Y alone. Clearly causality is being ascribed when there is a consistent correlation between a past event and a current event. In other words, the absence of correlation between past values of one variable X and that part of another variable Y which cannot be predicted from Y's own past, implies absence of causal influence from X to Y.

The problem with the Granger test is that since it applies to stationery time series with zero means, its application to raw (i.e. unfiltered or undifferenced) time series which are frequently monotonically increasing and thus non-stationary may be inappropriate (Allan and Hoa, 1981:27). Evidence of inappropriate application of the Grangers test is the presence of non-independent or non-white noise residuals in the estimated Equations. A white noise is actually a serially uncorrelated process. To obtain independent or white noise residuals, numerous pre-whitening procedures have sometimes been employed to transform economic time series.

Tobin (1970) criticises the Granger's test by saying that the sequence may sometimes be confused with consequence. This difficulty is avoided in informal causa-

lity tests by the removal of the systematic or deterministic components.

(b) The Direct Method

This is a procedure not actually suggested but implicitly contained in Granger's (1969) paper. It was developed by Haugh (1976) and applied by Sargent (1976). It is simply to regress X on its own past values and adding on the past values of Y, giving directly an estimate of the first. The possibility that Y causes X can be examined by testing whether the coefficients of lagged Y are zero. Within the model framework, it can be written as

$$\Delta \log X_t = \alpha_o + \sum_{i=1}^{k} \lambda_i \Delta \log X_{t-i} + \sum_{i=1}^{k} d_i \Delta \log Y_{t-1}$$

The testable hypothesis is that

$$\sum_{i=1}^{k} d_i = 0$$

This can be done by the utilization of the standard 't' test.

The main caution with this approach is to ensure that the specification is adequate (Pierce and Haugh,

1977:288). In other words, care should be taken in selecting the number of lags to eliminate possible serial correlation in errors (Ajayi, 1983:322).

(c) Causality Detection via Cross Correlating Univariate Residual Series

Haugh (1972) developed an approach to identify the degree and direction of association between two covariance stationary time series which immediately yields a causality detection procedure. It is distinguished from the procedure of Sims (1972) by (1) the use of cross-correlation analysis rather than regression analysis on the filtered data. (2) the use of separate filters on X_t and Y_t to ensure that each is very nearly pre-whitened and, (3) the empirical determination of these filters from the particular series realizations under study.

4.2 THE CHOICE OF MODEL

The model we applied in this research is the Sims causality test model. Its advantage over others not only rests on its pre-whitening procedure but also on its requirement of the evaluation of the absolute size as

well as the patterns of the estimated lag coefficients.

4.3 MODEL SPECIFICATION

Sims (1972) extended the causality test in the context of a bivariate distributed lag model. The test for unidirectional causality between Y and X, is 'to regress Y on current, past and future values of X..... then if causality runs from X to Y only, future values of X in the regression should have coefficients insignificantly different from zero as a group'.

Thus to test for causality between Y and X, we might estimate the model

$$Y_t = X_t + \sum_{i=1}^{n} \beta_i X_{t-i} + \sum_{i=1}^{m} \alpha_i X_{t+i} + U_t$$

where the first expression on the right hand side represents the current values of X, the second expression represents the usual distributed lag of X, in this case a finite n-period lag. The third expression on the right hand side represents a distributed lag of future values of X. If X affects Y but the causality is not reversed, we would expect the coefficients on the α's to be statistically insignificant individually as a group.

In order to apply the Sims test, all the variables were transformed by taking the quasi-second differences of the natural logarithms of the variables in order to reduce serial correlation in the residuals. This is so, since F tests which is applied in the model are highly sensitive to the presence of autocorrelation in the residuals. Therefore all variables used in the regression were measured as natural logarithms, and prefiltered using the filter, $1-1.5L + 0.5625L^2$, where L and L^2 are the lag operators (Chow, 1987:58). Thus each lagged variable X_t was replaced by $X_t - 1.5X_{t-1} + 0.5625X_{t-2}$. This filter approximately flattens the spectral density of most economic time series, and the hope is that regression residuals would be very nearly white noise with this prefiltering. In applying the Sims test, one has to specify a priori the length of the leading and lagging values of the independent variables.

Four sets of regression will be run in the two cases for each definition of money. Firstly, the values of GNP will be regressed on current, 3 past lags and 3 future values of changes in money supply. Then GNP is

regressed on current, 3 past lags of money supply. Thirdly, money supply is regressed on current, 3 past lags and 3 future values of GNP while the final set involves regressing money supply on current and 3 past lags of GNP. The same process applies to that of money supply and consumer price index (C.P.I.) . The Linear Equations will be of the form:

$GNP = f(M_1$, 3 past lags and 3 future values of $M_1)$

$GNP = f(M_1$, 3 past lags of $M_1)$

$M_1 = f(GNP$, 3 past lags and 3 future values of GNP)

$M_1 = f(GNP$, 3 past lags of GNP)

and

$M_1 = f(C.P.I$, 3 past lags and 3 future values of C.P.I.)

$M_1 = f(C.P.I.$, 3 past lags of C.P.I.)

$C.P.I. = f(M_1$, 3 past lags and 3 future values of $M_1)$

$C.P.I. = f(M_1$, 3 past lags of $M_1)$

Employing the alternative definition of money supply, we have the linear Equations as follows:

$GNP = f(M_2$, 3 past lags and 3 future values of $M_2)$

$GNP = f(M_2$, 3 past lags of $M_2)$

$M_2 = f(GNP$, 3 past lags and 3 future values of GNP)

M_2 = f(GNP, 3 past lags of GNP)

and

M_2 = f(C.P.I, 3 past lags and 3 future values of C.P.I)

M_2 = f(C.P.I, 3 past lags of C.P.I)

C.P.I = f(M_2, 3 past lags and 3 future values of M_2)

C.P.I.= f(M_2, 3 past lags of M_2)

It should be noted that two observations were lost in the transformation of the variables, and an additional three transformed variables were dropped in order to accommodate the three past lags. Each regression Equation included as did Sims (1972) a constant and a trend variable. Also three seasonal dummies were included in the regression involving quarterly data to take care of the various seasons and their effects.

4.4 EVALUATION OF RESULTS

Using Sims (1972) criterion the acceptance that there is unidirectional causality from M to GNP is only when future values of M in the regression have coefficients insignificantly different from zero as a group. The reverse unidirectional causality from GNP to M holds only when future values of GNP in the regression have

coefficients insignificantly different from zero. If the coefficients of the future values of M are significant in explaining movements in GNP, and similarly future values of GNP have coefficients which are significant in explaining M, then evidence of causation may be difficult to determine.

An F-test is employed to determine whether the coefficients of the three future variables as a group are insignificantly different from zero as independent variables. The F is calculated as follows (Chow, 1987:58),

$$F = \frac{(RSS_2 - RSS_1)/(df_2 - df_1)}{RSS_1/df_1}$$

$$F = \frac{(RSS_4 - RSS_3)/(df_4 - df_3)}{RSS_3/df_3}$$

where RSS_1, RSS_2, RSS_3, RSS_4 are the Residual sum of squares (1,2,3,4) for the four linear Equations of GNP and M. df_1, df_2, df_3, df_4 are the respective degrees of freedom. A similar exercise is carried out for the four linear equations of M and C.P.I.

Decision Rule,

If $F > f_{(k-1)(n-1),\ 0.05}$ we reject the hypothesis, otherwise we accept it.

Sims (1972) has qualified the interpretation of the F-test to some extent in two ways:

1. Even if the F-test indicates that the future coefficients are insignificant and unidirectional causality is possible, if the coefficients of the future variables are large or larger than the coefficients on past variables, then bi-directional causality may be important.
2. If the F-test shows that the future coefficients are statistically significant, they may still be ignored if small in value when compared to the coefficients on the past variables.

Apart from the F-test, other tests include the R^2 for testing the goodness of fit, the t-test for testing the significance of each regression coefficients, Durbin Watson 'd' statistic for testing the randomness of the residuals. Also, tests are conducted to ensure that the assumptions of the OLS are fulfilled. The assumptions, among others include, lack of serious

linear correlation between the explanatory variables and non-autocorrelated errors.

4.5 SHORTCOMINGS OF THE MODEL

The Sims (1972) model provides the best suitable statistical method for detecting causality in a bivariate distributed lag model. However some shortcomings have been noted about the model. Nevertheless, it is still widely used for causality tests. They are as follows:

(i) The possible existence of a third variable which, say, affects X more quickly than Y. In this case the future values of Y will be significant when explaining X even though X and Y may not be causally related. The fact that the results of a bivariate causality test may be altered when a third variable is added is analagous to the problem of specification in classical hypothesis testing (Myatt, 1986:139).

(ii) A serious difficulty is posed by the existence of expectations, when factors affecting one variable say Y, include the expected future

values of the other variable X, yet there is no causal relationship from X to Y. Sims (1972) has argued that the existence of expectations is more likely to make a structure where there is one way causality appear as if there is mutual causation, or to make bi-directional structure appear unidirectional. In the event of expectations being accurate, the future values of X may be significant when explaining Y owing to the autocorrelation of X.

(iii) The causality model involves a substantial loss of degrees of freedom because of both the lagging technique and the second-order differencing.

4.6 DATA NEEDED AND SOURCES

The necessary data for this research include money supply, both M_1 and M_2, GNP at current market prices, GNP per capita, consumer prices index. Quarterly time-series data for the period 1970-1985 were got for money supply and consumer prices index, while Annual time series data for the period 1970-1988 were got for GNP and money supply too. Quarterly time series data would have been excellent alternatives but because data on

GNP are given only on annual basis, the annual data are used in that respect. While we are aware of the existence of techniques of extrapolating or constructing quarterly time series from annual ones, we are suspicious of the appropriateness of such complex techniques in the present study.

The data will be obtained mainly from CBN Annual Reports and Statement of Accounts, CBN Economic and Financial Reviews, IMF International Financial Statistics and the World Bank tables.

CHAPTER FIVE

REGRESSION RESULTS

The results of the regressions specified in 4.2 are presented in this chapter. The estimates are subjected to various statistical tests. On the basis of the empirical evidence provided by the results, the hypotheses of the research are evaluated. In the regression equations with seasonal dummies, the coefficients of the seasonal dummies are not reported, since in all cases, they are highly insignificant.

5.1 PRESENTATION OF REGRESSION RESULTS

The OLS estimates of the key functions specified in 4.2 are as follows:

(1) $$P_t = \underset{}{0.2487} + \underset{(4.45)}{0.3305}M_{1t} + \underset{(1.85)}{0.1624}M_{1t-1}$$

$$+ \quad 0.1168\ M_{1t-2} - \underset{(4.42)}{0.3771}\ M_{1t-3} + \underset{(9.41)}{0.9064}\ M_{1t+1}$$

$$- \quad \underset{(2.44)}{0.2493}\ M_{1t+2} - \underset{(1.46)}{0.1330}\ M_{1t+3}$$

$$R = 0.65232$$

$$DW = 2.80092$$

(2) $P_t = 0.3046 + \underset{(3.83)}{0.2564}\ M_{1t} + \underset{(1.76)}{0.1974}\ M_{1t-1}$

$+ \underset{(2.08)}{0.1276}\ M_{1t-2} - \underset{(2.13)}{0.1424}\ M_{1t-3}$

$R = 0.59869$

$DW = 2.81216$

(3) $M_{1t} = 0.2294 + \underset{(3.42)}{0.9625}\ P_t + \underset{(1.01)}{0.3303}\ P_{t-1}$

$- \underset{(0.41)}{0.1401}\ P_{t-2} - \underset{(0.36)}{0.1230}\ P_{t-3} + \underset{(1.16)}{0.3752}\ P_{t+1}$

$\underset{(1.02)}{0.3449}\ P_{t+2} + \underset{(1.32)}{0.4424}\ P_{t+3}$

$R = 0.58598$

$DW = 2.73678$

(4) $M_{1t} = 0.9233 + \underset{(3.58)}{0.9714}\ P_t + \underset{(1.64)}{0.4364}\ P_{t-1}$

$+ \underset{(0.38)}{0.1023}\ P_{t-2} + \underset{(0.48)}{0.1303}\ P_{t-3}$

$R = 0.55674$

$DW = 2.73330$

(5) $P_t = 0.2738 + \underset{(3.63)}{0.4993}\ M_{2t} + \underset{(0.78)}{0.1067}\ M_{2t-1} + \underset{(1.65)}{0.2344}\ M_{2t-2}$

$- \underset{(7.32)}{0.9364}\ M_{2t-3} - \underset{(0.81)}{0.1215}\ M_{2t+1} - \underset{(0.86)}{0.1345}\ M_{2t+2}$

$- 0.2507\ M_{2t+3}$

$R = 0.65220$

$DW = 2.56741$

(6) $P_t = 0.1706 + \underset{(3.16)}{0.3622}\ M_{2t} + \underset{(5.27)}{0.4849}\ M_{2t-1}$

$+ \underset{(2.10)}{0.1936}\ M_{2t-2} - \underset{(8.78)}{0.9785}\ M_{2t-3}$

$R = 0.16277$

$DW = 2.70763$

(7) $M_{2t} = 0.1922 + \underset{(3.80)}{0.6377}P_t + \underset{(1.46)}{0.2834}P_{t-1} + \underset{(0.76)}{0.1561}P_{t-2}$

$+ \underset{(1.99)}{0.4010}P_{t-3} + \underset{(1.43)}{0.2760}P_{t+1} + \underset{(1.88)}{0.3763}P_{t+2}$

$+ \underset{(0.56)}{0.1114}P_{t+3}$

$R = 0.72570$

$DW = 2.59061$

(8) $M_{2t} = 0.1899 + \underset{(3.99)}{0.6663}P_t + \underset{(2.52)}{0.4119}P_{t-1} + \underset{(1.65)}{0.2712}P_{t-2}$

$+ \underset{(1.56)}{0.2598}P_{t-3}$

$R = 0.6855$

$DW = 2.51133$

(9) $Y_t = -0.3328 - \underset{(0.68)}{0.4786M_{1t}} - \underset{(0.33)}{0.2618M_{1t-1}}$

$\underset{(0.56)}{-0.2369M_{1t-2}} + \underset{(0.49)}{0.2405M_{1t-3}} + \underset{(1.16)}{1.2188M_{1t+1}}$

$+ \underset{(0.195)}{0.11782M_{1t+2}} + \underset{(1.92)}{1.1219M_{1t-3}}$

$R = 0.90249$

$DW = 2.07340$

(10) $Y_t = 0.6902 - \underset{(0.52)}{0.2339M_{1t}} - \underset{(1.76)}{0.82233M_{1t-1}}$

$\underset{(1.27}{- 0.5667M_{1t-2}} - \underset{(0.95)}{0.4029M_{1t-3}}$

$R = 0.63446$

$DW = 2.24637$

(11) $M_{1t} = 0.2118 + \underset{(0.38)}{0.1254Y_t} + \underset{(1.59)}{0.5591Y_{t-1}} - \underset{(0.48)}{0.1726Y_{t-2}}$

$\underset{(0.67)}{- 0.2078Y_{t-3}} - \underset{(1.87)}{0.7318Y_{t+1}} + \underset{(1.62)}{0.5301Y_{t+2}}$

$\underset{(1.80)}{+ 0.5312Y_{t+3}}$

$R = 0.93644$

$DW = 1.43088$

(12) $M_{1t} = 0.3629 + \underset{(1.69)}{0.5477}Y_t + \underset{(2.94)}{0.9196}Y_{t-1}$

$+ \underset{(1.27)}{0.3485}Y_{t-2} + \underset{(1.23)}{0.2646}Y_{t-3}$

$R = 0.79670$

$DW = 2.11105$

(13) $Y_t = -0.6687 + \underset{(0.46)}{0.5251}M_{2t} + \underset{(0.46)}{0.6355}M_{2t-1}$

$+ \underset{(0.14)}{0.1136}M_{2t-2} + \underset{(0.15)}{0.1395}M_{2t-3} + \underset{(1.05)}{1.4117}M_{2t+1}$

$+ \underset{(0.37)}{0.2152}M_{2t+2} + \underset{(1.78)}{0.9628}M_{2t+3}$

$R = 0.87978$

$DW = 2.08375$

(14) $Y_t = 0.8857 - \underset{(0.22)}{0.1097}M_{2t} - \underset{(2.35)}{1.2164}M_{2t-1}$

$- \underset{(0.58)}{0.2822}M_{2t-2} - \underset{(1.58)}{0.7346}M_{2t-3}$

$R = 0.74323$

$DW = 2.31780$

$$(15)\quad M_{2t} = \underset{}{0.3370} + \underset{(1.06)}{0.1929}Y_t + \underset{(1.95)}{0.3782}Y_{t-1} - \underset{(1.67)}{0.3301}Y_{t-2}$$

$$- \underset{(1.37)}{0.2337}Y_{t-3} - \underset{(2.69)}{0.5796}Y_{t+1} - \underset{(3.70)}{0.6686}Y_{t+2}$$

$$+ \underset{(2.69)}{0.4391}Y_{t+3}$$

$R = 0.96940$

$DW = 1.82828$

$$(16)\quad M_{2t} = \underset{}{-0.1621} + \underset{(2.35)}{0.5407}Y_t + \underset{(3.02)}{0.6741}Y_{t-1} + \underset{(0.65)}{0.1288}Y_{t-2}$$

$$+ \underset{(0.76)}{0.1172}Y_{t-3}$$

$R = 0.83666$

$DW = 2.11184$

TABLE I: SUMMARY OF REGRESSION RESULTS

		F	$\bar{R}^2$	S.E.E.	D.F.
1.	$P_t = f(M_{1t}$, 3 past, 3 future)	4.127	0.322	0.0223	39(7)
2.	$P_t = f(M_{1t}$, 3 past)	5.866	0.297	0.0227	42(4)
3.	$M_{1t} = f(P_t$, 3 past, 3 future)	2.913	0.225	0.0483	39(7)
4.	$M_{1t} = f(P_t$, 3 past)	4.716	0.244	0.0477	42(4)
5.	$P_t = f(M_{2t}$, 3 past, 3 future)	4.124	0.322	0.0223	39(7)
6.	$P_t = f(M_{2t}$, 3 past)	6.313	0.316	0.0224	42(4)
7.	$M_{2t} = f(P_t$, 3 past, 3 future)	6.198	0.442	0.0287	39(7)
8.	$M_{2t} = f(P_t$, 3 past)	9.310	0.419	0.0293	42(4)
9.	$Y_t = f(M_{1t}$, 3 past, 3 future)	1.881	0.382	0.05173	3(7)
10.	$Y_t = f(M_{1t}$, 3 past)	1.010	0.004	0.06564	6(4)
11.	$M_{1t} = f(Y_t$, 3 past, 3 future)	3.053	0.589	0.03933	3(7)
12.	$M_{1t} = f(Y_t$, 3 past)	2.606	0.391	0.04791	6(4)

No		F	$\bar{R}^2$	S.E.E.	D.F.
13.	Y_t = f(M_{2t}, 3 past, 3 future)	1.467	0.246	0.05709	3(7)
14.	Y_t = f(M_{2t}, 3 past)	1.851	0.254	0.05682	6(4)
15.	M_{2t} = f(Y_t, 3 past, 3 future)	6.683	0.799	0.02170	3(7)
16.	M_{2t} = f(Y_t, 3 past)	3.500	0.500	0.03423	6(4)

The figures in parentheses under the parameter estimates are the corresponding t-ratios. R, the coefficient of correlation measures the degree of association of the regressors and the regressand. The Durbin-Watson (D.W.) statistic is useful for testing autocorrelation. In the summary table (Table I), the F, is the variance ratio used to test whether the joint influence of the regressors on the regressand is statistically significant. The $\bar{R}^2$ is the coefficient of multiple determination adjusted for the degress of freedom. It is a general indication of the goodness of fit or the explanatory power of the Equation. The standard errors are also given, which will help in determining the degree

of confidence in the validity of the estimates, and also in measuring the size of the sampling errors.

In Table I, the relationship involving P and M_1, shows that the two equations with price (P) as dependent variable have a higher goodness of fit and also lower standard errors of estimate than those with M_1 as the dependent variable. As a matter of fact, there is no general agreement among econometricians as to which of the two statistical criteria is more important: a high R^2, or a low standard errors of estimate. However, Koutsoyiannis (1977:97) believes that a high R^2 has a clear merit only when combined with low standard error of estimate. Thus when a high R^2 and low standard errors are not found comtemporaneously in a particular study, the researcher should be very careful in his interpretation and acceptance of results. In the regression Equations involving P and M_2, the Equations with M_2 as the dependent variable have higher goodness of fit than the Equations with P, as the dependent variable but the latter have lower standard errors than the former. In the regression Equations involving Y and M_1, the Equations

with M_1 as the dependent variable have higher goodness of fit, and lower standard errors of estimate than the Equations with Y_t as the dependent variable. Similarly, in the regressions involving Y and M_2, the Equations with M_2 as dependent variable have higher goodness of fit and lower standard errors than the Equations with Y as the dependent variable.

In general, the regressions using M_2 yield somewhat higher goodness of fit and lower standard errors of estimate than the regressions using M_1.

5.2 STATISTICAL TESTS OF SIGNIFICANCE

Two sets of tests of significance are carried out.

(1) The F-test, to ascertain the joint impact of the explanatory variables, that is, test of estimators significance taken jointly.

(2) An F-test is also carried out specifically to test the significance of the future variables coefficients. This is for the causality test as shown in Table II.

In the F-test described in (1) above, the observed F-ratio, F^*, is compared with the theoretical F-ratio,

$F_{0.05}$, which has degrees of freedom $V_1 = k-1$ and $V_2 = n-k$, (n is the sample size and k is the total number of parameters estimated).

The decision rules are:

A. If $F^* \geq F_{0.05}$, reject H_o. This implies that the explanatory variables have a significant joint influence on the regressand.

B. If $F^* < F_{0.05}$, accept H_o, This implies that the joint influence of the explanatory variables on the regressand is not significant. The results are shown in Table III.

TABLE II: F-TEST FOR SIGNIFICANCE OF FUTURE VARIABLES COEFFICIENT - THE CAUSALITY TEST

Causal Pattern	Regression Equation	F
$M_1 - P$	P on M_1	0.65
$P - M_1$	M_1 on P	1.94
$M_2 - P$	P on M_2	0.95
$P - M_2$	M_2 on P	1.67
$M_1 - Y$	Y on M_1	8.65
$Y - M_1$	M_1 on Y	0.87
$M_2 - Y$	Y on M_2	0.97
$Y - M_2$	M_2 on Y	13.7

TABLE III - F-TEST

Eqn. No.	Estimated Equation	R^2	F* Ratio/ df	Result of F-test
1	$P_t = f(M_{1t}$, 3 past, 3 future)	0.42552	4.13(7,39)	S
2	$P_t = f(M_{1t}$, 3 past)	0.35845	5.87(4,42)	S
3	$P_t = f(M_{2t}$, 3 past, 3 future)	0.42537	4.12(7,39)	S
4	$P_t = f(M_{2t}$, 3 past)	0.37549	6.31(4,42)	S
5	$M_{1t} = f(P_t$, 3 past, 3 future)	0.34337	2.91(7,39)	S[b]
6	$M_{1t} = f(P_t$, 3 past)	0.30996	4.71(4,42)	S
7	$M_{2t} = f(P_t$, 3 past, 3 future)	0.52664	6.19(7,39)	S
8	$M_{2t} = f(P_t$, 3 past)	0.46997	9.31(4,42)	S
9	$Y_t = f(M_{1t}$, 3 past, 3 future)	0.81449	1.88(7,3)	NS
10	$Y_t = f(M_{1t}$, 3 past)	0.40254	1.01(4,6)	NS
11	$Y_t = f(M_{2t}$, 3 past, 3 future)	0.77401	1.46(7,3)	NS
12	$Y_t = f(M_{2t}$, 3 past)	0.55239	1.85(6,4)	NS

Eqn. No.	Estimated Equation	R^2	F* Ratio/ df	Results of F-test
13	M_1t = f(Y_t, 3 past, 3 future)	0.87692	3.05(7,3)	NS
14	M_{1t} = f(Y_t, 3 past)	0.63473	2.60(4,6)	NS
15.	M_{2t} = f(Y_t, 3 past, 3 future)	0.93974	6.68(7,3)	NS
16	M_{2t} = f(Y_t, 3 past)	0.70000	3.5 (4,6)	NS

Notes: 1. S = Significant (Reject H_o, Accept H_1)

2. NS = Not significant (Accept H_o, Reject H_1)

3. b = NS at the 0.01 level

5.3 EXAMINATION OF ALGEBRAIC SIGNS OF PARAMETER ESTIMATES

How far do the directions of the influences of the various explanatory variables on the dependent variable conform with a priori expectations. "Wrong signs are usually warnings of incorrect definitions, specifications or interpretations (Rao and Miller, 1977:44)". As a matter of fact, the Sims test requires the evaluation of the absolute size as well as the patterns of the estimated lag coefficients. In equation (1), the coefficients of current and past lags are much more significant than the coefficient of future values. An evaluation of the coefficients of past lags indicates that for most of the lags, the net effect on the dependent variable, price, is positive, while for most of the coefficients on future

values, it is negative. This conforms with the expectation of unidirectional causality from M_1 to the price level. It is also noticed that the size of the coefficients decreases as the lag increases. This is expected since preceding quarterly values of M_1 appear to be more important in explaining price behaviour than other past values. In the reverse causality regression of M_1 on P, most of the coefficients on past lags are insignificant and negative while all the coefficients of future values are much more significant and with positive signs.

In the regression Equation (5), involving P on M_2, the coefficients of past variables have positive signs while the coefficients of future variables have negative signs. This also conforms with the a priori expectation of causality from M_2 to P. On the other hand, the regression Equation involving M_2 on P has positive signs for both the coefficients of past and future values of P.

In Equation (9), where Y has been regressed on M_1, the coefficients of past variables are insignificant and most have negative signs whereas the coefficients of

future variables are more significant and have positive signs. This is in contrast to a priori expectation that changes in money supply lead to changes in output. The reverse causality regression test of M_1 on Y shows negative signs on some of the future values. In Equation 13, where Y was regressed on M_2, all the coefficients of both past and future values have positive signs.

5.4 TESTS FOR AUTOCORRELATION

In order to ascertain the reliability of the parameter estimates, the realism of the assumptions of non-autocorrelation are tested. This test is carried out to ensure that the prefiltering procedure adopted in the research successfully reduced serial correlation in the residuals.

Autocorrelation Test Procedure

The theoretical lower and upper limits of the Durbin-Watson statistics d_L and $4-d_L$ respectively are compared with the observed D.W. statistics, d*. If $d_L < d^* < (4-d_L)$ autocorrelation is not a serious problem in the Equation. If $d^* < d_L$ or $d^* > (4-d_L)$, there is serious autocorrelation. In this test, the D.W. limits are based

on a 5 per cent level of significance and k degrees of freedom, where k is the number of regressors in the Equation under examination. A limitation in the test is the fact that values of k given in the d_L table stops only at 5 explanatory variables. However, we developed a method of estimating the d_L values of up to 7 explanatory variables. The method is explained. With n as 39, the values of d_L decreases arithmetically by 0.05 as k increased. Thus if k is 7, the value of d_L becomes $d_L(k=5) - 2(0.05)$. We are however unable to test for autocorrelation in all the regression Equations between Y and M. This is because the sample size n is smaller than the n, for which the values are presented in the d_L tables. We are equally aware of the arithmetical possibility of intrapolating the sample size n to our required size in order to obtain the d_L values. However, because of precision, we do not intend to proceed with the exercise in this circumstance.

TABLE IV - RESULTS OF AUTOCORRELATION TESTS

Equation No	Observed DW (d*)	Theoretical D.W. Limits		Test Result
		d_L	$4-d_L$	
1.	2.80	1.12	2.88	FA
2.	2.81	1.13	2.87	FA
3.	2.74	1.12	2.88	FA
4.	2.73	1.13	2.87	FA
5.	2.57	1.12	2.88	FA
6.	2.70	1.13	2.87	FA
7.	2.58	1.12	2.88	FA
8.	2.51	1.13	2.87	FA

Note: FA = Free of serious autocorrelation

The results show that the regression Equations are free of serious autocorrelation. This implies that the variances of the parameter estimates calculated on the assumption of absence of autocorrelation are valid. Consequently, the statistical tests of significance of the parameter estimates are valid. Reliable interpretations can therefore be made of the estimates of 5.1.

5.5 SUMMARY OF FINDINGS

The empirical results can be summarized as follows: From the F-tests for significance of the future variables coefficients presented in table II, the future coefficients in all the regressions of prices on money supply are insignificantly different from zero as a group. The reverse causality regression of money supply on prices had coefficients somewhat significant. However, Sims (1972:545) has qualified the interpretation of the F-test to some extent. Even if the F-test indicates that the future coefficients are insignificant and unidirectional causality is possible, if the coefficients of the future variables are as large or larger than the coefficients on past variables, then bidirectional causality may be important. In Equation (3) where M_1 has been regressed on P, the coefficients of future variables are larger than the coefficients on past variables. Also in Equation (7) where M_2 has been regressed on P, the coefficients on future values are as large as those on past lags. Thus from the F-test, and the Sims qualification of the F-test, there appears

to be a little bidirectional causality between money supply (both M_1 and M_2) and the price level in Nigeria. However, the important influence as shown by the F-test in table II is from money supply to the price level.

In the relationship between money supply and GNP, the F-test presented in table II, shows that future values of M_1 have coefficients which are significant as a group in explaining the Y dependent variable, while the future values of Y are almost insignificant as a group in explaining the M_1 dependent variable. Turning to the results for M_2 and Y, a different empirical result holds. The future values of M_2 have coefficients insignificantly different from zero as a group, while the future coefficients of Y are highly significant as a group in explaining the M_2 dependent variable. It thus appears that from the F-test, causality runs from Y to M_1 and also from M_2 to Y. However, an examination of the absolute size of the lag coefficients with respect to Sims (1972) qualification of the F-test shows that while bidirectional causality may be important in the relationship between M_1 and Y, it is not fully noticed in the

regressions between M_2 and Y.

The empirical evidence indicates that the direction of causality between money supply and GNP in Nigeria is less clear-cut than for example, that which Sims (1972) found in his examination of the U.S. data. We found for Nigeria some evidence of unidirectional causality running from M_2 to GNP. There is also evidence of unidirectional causality from GNP to M_1, and some little influence from M_1 to GNP. One would expect M_1 to be as responsive to real output as M_2.

5.6 EVALUATION OF WORKING HYPOTHESES

The empirical evidence from the analysis is used to evaluate the hypotheses of this study. The first hypothesis that causality is unidirectional from money supply to GNP does not have full conclusive evidence to support this stance. This is because different empirical results are obtained for the influence of M_1 and M_2 on GNP. This is in contrast to a priori expectation that changes in money supply, whether defined as M_1 or M_2 would lead to changes in GNP.

The second hypothesis that causality is unidirectional

from money supply to consumer price index (C.P.I.) is supported by the empirical findings. For both definitions of money supply, it is clear that causation runs from money supply to the price level. Hypothesis three holds somewhat. This is because a little influence is found from the price level to money supply.

Evidence for hypothesis four is as inconclusive as the evidence for hypothesis one. This is because while a reverse unidirectional causality exists from GNP to M_1, no substantial reverse causation is noticed from GNP to M_2. Hypothesis five also holds somewhat, A little bidirectional causation is noticed between money supply and the price level and also between M_1 and GNP.

CHAPTER SIX

IMPLICATIONS OF THE RESULT

The results of the regression equations discussed have theoretical, empirical as well as policy implications. If as the monetarists assert, the money stock plays the central role in the determination of the level of economic activity, one would expect the same results obtained for the U.S., to hold for developing countries like Nigeria. The fact that, using Nigerian data for 1970-1988, we established a unidirectional causality from money supply to the price level, but were unable to establish a clear-cut unidirectional causality between money supply (both M_1 and M_2) and GNP warns that one has to be careful in interpreting the relevance of the monetarist proposition in Nigeria.

6.1 THEORETICAL AND EMPIRICAL IMPLICATIONS

A. A Note on the Exogenity of Money Supply

A basic analogy that underlie the concept that money does matter is the fact that changes in the quantity of money are capable of being controlled fairly accurately by deliberate policy (Wonnacott, 1984:550). Thus exogenity of money supply ensures that monetary impulses

are transmitted to economic activity. It is now assumed invalid for a number of reasons to believe that money supply is exogenously determined in Nigeria. Such writers as Ajayi (1978) and Okah (1985) argue that money supply in Nigeria cannot be directly controlled by the monetary authorities. Rather, changes in money supply is a result of the portfolio decisions of the non-bank public, the commercial banks and the central monetary authorities. Coghlan (1981) believes that if money supply is endogenously determined, attempts to identify unidirectional causality between money and nominal income may be unrealistic. This is because if the supply of money is endogenously determined, it operates as a channel through which the separate influences on the money supply work through their way to the economy.

B. An Explanation for Statistically Significant but Wrongly Signed Regressor Coefficient

A common cause of worry in empirical research is the appearance of 'wrongly' signed coefficients in regression models. Rao and Miller (1971:46) argue that in every empirical research "when the coefficient is significantly different from zero and has the wrong sign, then

some aspect of the problem has not been unvieled". Such a wrong sign, they believe, may be a warning of incorrect definitions, specifications or interpretations. Nwankwo (1985:106) attributes it to the "misconception of an explanatory macrovariable as influencing a dependent variable in a particular direction, whereas such an explanatory macrovariable is actually made up of components which influence the dependent variable in opposing directions. Soludo (1987:152) adds that at times, the heterogenous composition of the dependent variable rather than the explanatory variable could be the source of the problem. In such an instance, the dependent variable is made up of components that are functionally related to the given macro explanatory variable in opposing directions.

In our case, the regression of M_1 and M_2 on GNP assumes that all components of M_1 or M_2 as the explanatory variable influence GNP, or in the reverse sense, that all components of GNP as the explanatory variable influence M_1 or M_2. This is erroneous. For instance M_1 includes currency outside banks plus privately held demand deposits while M_2 includes in addition to M_1, the sum of savings

and time deposits in the commercial banks. These are all components of money supply which may individually influence the dependent variable in opposite directions.

C. The Influence of the Structure of the Economy

Vaish (1977:357) conveys the idea that the maintenance of domestic price stability and a fixed realistic foreign exchange rate is a most important pre-requisite for money supply to achieve maximum rate of sustained economic growth in developing countries. This is because rapidly rising prices and frequently fluctuating foreign exchange rate will seriously hamper the rate of sustained economic growth by retarding the process of capital accumulation by discouraging domestic savings, by impeding the net inflow of foreign capital for productive purposes, and by making it difficult to allocate the scarce resources optimally. Also, an increase in money supply under the flexible exchange rates could bring about rise of the price level. It also lowers the rate of interest ceteris paribus, the lower the rate of interest, the more capital leaks out. Such an outflow will not only deteriorate the exchange rate but will also reduce the domestic sector output.

6.2 POLICY IMPLICATIONS

A. The Money - Price Linkage

This study indicates that changes in the price level in Nigeria are to an extent caused by changes in money supply. It may thus be seen that a way to curb the inflationary trend in Nigeria effectively is through a rational supply of money process. As Osakwe (1983) puts it succintly, "a short run policy designed to control inflation should take cognisance of the slow and cumulative impact of changes in money supply on the price level. It is necessary to point out that inflation in Nigeria should be attributed to other factors beyond the money definition. The empirical results shows that changes in the price level can affect money supply, though the important influence is from money supply to the price level. It is certainly possible for prices to rise somewhat without an increase in the money supply. It is also possible to have a large increase in money supply with little or no increase in price. Nevertheless, it may be difficult to envisage a really large-scale inflation without a substantial increase in money supply.

The monetarist policy prescription has always been that "If price stability is to be maintained, the rate of monetary expansion must be equal to the rate of growth of output, assuming that the ratio of income to real cash balances is constant overtime". Thus the monetarists are not worried so long as the quantity of money does not rise more rapidly than the rate of growth of national output. Oke and Nwade (1977) recognise this idea and warn that unless the growth rate of money supply in Nigeria is reduced to a level close to the growth rate of real output, the inflationary pressure would persist.

While it is necessary to manipulate money supply to achieve price stability, what one may not completely recommend is the idea of rigid adherence to quantitative targets for the growth rate of money supply in order to achieve an equilibrium with output growth. Such targets may be a source of chronic instability for domestic financial markets and may damage industrial confidence.

B. The Money - GNP Linkage

The results of this study show that the relationship between money supply and GNP in Nigeria is a particularly

complex one. In some cases within the data period, GNP influenced money supply (M_1) and in other cases, money supply (M_2) influenced GNP. Also a little influence is found from M_1 to GNP. The result does not completely cast doubt on the role of monetary policy in promoting sustained economic growth in the economy. In short, monetary policy can help in promoting economic growth by creating a favourable environment for savings and investment and ensuring full use of economy's total productive resources. However the conduct of monetary policy aimed at influencing the composition of output in a developing economy such as Nigeria characterised by structural disequilibra may be an ardous task. At times, money supply movements may have been reversed so quickly that GNP is virtually unaffected due to the adverse effects on the Balance of Payments. At other times the results that GNP leads money supply are in a large part explained by the endogenity of the Nigeria money supply. In this case, money supply adjusts due to changes in the demand for money.

This study essentially highlights the fact that in

an economy characterized by structural rigidities and such other imperfections relating to both the foreign exchange management and money supply control, the achievement of economic growth may be somehow unrealistic.

CHAPTER SEVEN

SUMMARY AND CONCLUSION

This research has been concerned with identifying the cause-effect and lead-lag relationships between money supply and GNP and between money supply and the level of prices in Nigeria. It is borne out by the fact that monetary policies in Nigeria over the years has centered around the control of money stock in order to ensure economic growth and a stable price level. Despite these attempts, the economy is not yet sound, and inflation is not yet under control. In the light of such uncanny experiences, we sought to find out whether indeed, the control of the money stock in a developing economy like Nigeria could infact lead to changes in the output or price level. Specifically, we sought to provide empirical insight using Nigerian data into the monetarist view of the role of money in the economy and in particular, Friedman's view of the monetary mechanism.

The review of relevant literature in chapter two shows that the role money plays in economic activity has always attracted the attention of economists. But there has been sharp disagreements over the nature of this role

in different countries. While policy makers in Nigeria seem to accept the monetarist proposition of the role of money, certain other economists have increasingly come to argue that money supply does not have any remarkable effect on the level of economic activity. The empirical literature shows that none of the earlier studies has adequately addressed the problems of this research. Most of the models applied earlier, are shown to be simple and incapable of elucidating the proper problem identified in the research.

The methodology of the research is econometric. Apart from the Sims model applied in the research, we presented other econometric models capable of detecting causality in a bivariate system. A total of sixteen Equations were specified and estimated. Money supply was divided between narrow and broad definitions (M_1 and M_2). The Equations parameters were specified in consonance with the test for causality.

The results of the regressions involving money supply and the price level show that while causality may flow from the price level to money supply, the important

influence is from money supply to the price level. The results of the regressions between GNP and money supply show that while M_2 may be causing GNP, GNP on the other hand influences M_1. Also, a little influence is seen from M_1 to GNP.

The theoretical and policy implications are discussed. The following arguments have been advanced.

(a) Despite the fact that causality runs mainly from money supply to the price level, it is certainly possible for prices to rise somewhat without an increase in the money supply. Thus policies aimed at fighting inflation should go beyond the money supply process.

(b) A reason is advanced for the appearance of statistically significant but wrongly signed regressor coefficient. The 'wrong sign' may be the misconception of an explanatory variable as influencing a dependent variable in a particular direction, whereas such an explanatory macro variable is actually made up of components which influence the dependent variable in opposing directions.

(c) Certain structural rigidities such as the level of unemployment, may drastically affect the causality influence of money supply on GNP or the price level.

The research demonstrates the empirical and theoretical role of money supply in the Nigerian economy. Money supply being an important tool in the nation's economic management, the analysis herein does not provide a complete study of its role. The issues raised herein provide an agenda for further research. In view of this, the writer intends to undertake further research along the following lines: disagregating the various components of money supply and testing the influence of each on GNP and the price level; and the examination of the application of the model of this research to other less developed countries with similar structural rigidities.

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APPENDIXES

UNIVERSITY OF NIGERIA
COMPUTING CENTRE
General Purpose Coding Form

PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC									PAGE OF
PROGRAMMER	DATE		PUNCH									

	Y_t	M_{1t}	M_{1t-1}	M_{1t-2}	M_{1t-3}	M_{1t+1}	M_{1t+2}	M_{1t+3}	Y_{t-1}	Y_{t-2}	Y_{t-3}	Y_{t+1}	IDENTIFICATIONS SEQUENCE
1	1975	0.181	0.345	0.294	0.224	0.214	0.279	0.267	0.164	0.500	0.302	0.185	0.309
2	1976	0.309	0.279	0.345	0.294	0.224	0.267	0.164	0.299	0.181	0.500	0.302	0.280
3	1977	0.280	0.267	0.279	0.345	0.294	0.164	0.299	0.367	0.309	0.181	0.500	0.261
4	1978	0.261	0.164	0.267	0.279	0.345	0.299	0.367	0.173	0.280	0.309	0.181	0.442
5	1979	0.442	0.299	0.164	0.267	0.279	0.367	0.173	0.249	0.261	0.280	0.309	0.251
6	1980	0.251	0.367	0.299	0.164	0.267	0.173	0.249	0.293	0.442	0.261	0.280	0.283
7	1981	0.283	0.173	0.367	0.299	0.164	0.249	0.293	0.259	0.251	0.442	0.261	0.306
8	1982	0.306	0.249	0.173	0.367	0.299	0.293	0.259	0.273	0.283	0.251	0.442	0.279
9	1983	0.279	0.293	0.249	0.173	0.367	0.259	0.273	0.219	0.306	0.283	0.251	0.328
10	1984	0.308	0.259	0.293	0.249	0.173	0.273	0.219	0.335	0.279	0.306	0.283	0.362
11	1985	0.362	0.273	0.259	0.293	0.249	0.219	0.335	0.352	0.308	0.279	0.306	0.368
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5	1979		0.283 0.306 0.329 0.206 0.268 0.259 0.354 0.200 0.279	
6	1980		0.306 0.279 0.354 0.329 0.206 0.268 0.200 0.279 0.304	
7	1981		0.279 0.308 0.200 0.354 0.329 0.206 0.279 0.304 0.281	
8	1982		0.308 0.362 0.279 0.200 0.354 0.329 0.304 0.281 0.237	
9	1983		0.362 0.368 0.304 0.279 0.200 0.354 0.281 0.287 0.256	
10	1984		0.368 0.387 0.281 0.304 0.279 0.200 0.287 0.256 0.363	
11	1985		0.387 0.398 0.287 0.281 0.304 0.279 0.256 0.363 0.335	
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1	9	7	7	I		0.156	0.254	0.273	0.250	0.162	0.153	0.309	0.228	0.123	0.143	0.123	0.140	
2				II		0.140	0.153	0.254	0.273	0.250	0.309	0.228	0.225	0.156	0.123	0.143	0.126	
3				III		0.136	0.309	0.153	0.254	0.273	0.228	0.225	0.208	0.140	0.156	0.123	0.139	
4				IV		0.139	0.228	0.309	0.153	0.254	0.225	0.208	0.249	0.136	0.140	0.156	0.159	
5	1	9	7	8	I	0.159	0.225	0.228	0.309	0.153	0.208	0.249	0.233	0.139	0.136	0.140	0.151	
6					II	0.151	0.208	0.225	0.228	0.309	0.249	0.233	0.249	0.159	0.139	0.136	0.123	
7					III	0.123	0.249	0.208	0.225	0.228	0.233	0.249	0.327	0.151	0.159	0.139	0.147	
8					IV	0.147	0.233	0.249	0.208	0.225	0.249	0.327	0.146	0.123	0.151	0.159	0.162	
9	1	9	7	9	I	0.162	0.249	0.233	0.249	0.208	0.327	0.146	0.241	0.147	0.123	0.151	0.145	
10					II	0.148	0.327	0.249	0.233	0.249	0.146	0.241	0.311	0.162	0.147	0.123	0.143	
11					III	0.143	0.146	0.327	0.249	0.233	0.241	0.311	0.169	0.148	0.162	0.147	0.162	
12					IV	0.142	0.241	0.146	0.327	0.249	0.311	0.169	0.314	0.143	0.148	0.162	0.154	
13	1	9	8	0	I	0.154	0.311	0.241	0.146	0.327	0.169	0.314	0.301	0.142	0.143	0.148	0.145	
14					II	0.145	0.169	0.311	0.241	0.146	0.314	0.301	0.145	0.154	0.142	0.143	0.166	
15					III	0.166	0.314	0.169	0.311	0.241	0.301	0.145	0.290	0.145	0.154	0.142	0.136	
16					IV	0.136	0.301	0.314	0.169	0.311	0.148	0.290	0.256	0.166	0.145	0.154	0.181	
17	1	9	8	1	I	0.181	0.148	0.301	0.314	0.169	0.290	0.256	0.271	0.136	0.166	0.145	0.154	
18					II	0.154	0.290	0.148	0.301	0.314	0.256	0.271	0.188	0.181	0.136	0.166	0.157	
19					III	0.157	0.256	0.290	0.148	0.301	0.271	0.188	0.268	0.154	0.181	0.136	0.140	
20					IV	0.140	0.271	0.256	0.290	0.148	0.188	0.268	0.259	0.157	0.154	0.181	0.134	
21	1	9	8	2	I	0.134	0.188	0.271	0.256	0.290	0.268	0.259	0.285	0.140	0.157	0.154	0.169	
22					II	0.169	0.268	0.188	0.271	0.256	0.259	0.285	0.192	0.134	0.140	0.157	0.154	
23					III	0.154	0.259	0.268	0.188	0.271	0.285	0.192	0.294	0.169	0.134	0.140	0.157	
24					IV	0.157	0.285	0.259	0.268	0.181	0.192	0.294	0.279	0.154	0.169	0.134	0.180	
1	2	3	4	5	6	7 8 9 10 11 12	13 14 15 16 17	18 19 20 21 22	23 24 25 26 27	28 29 30 31 32	33 34 35 36 37	38 39 40 41 42	43 44 45 46 47	48 49 50 51 52	53 54 55 56 57	58 59 60 61 62	63 64 65 66 67	68 69 70 71 72	73 74 75 76 77 78 79 80

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1	1971	II	0.117	0.089	0.148	0.242	0.173	0.232	0.208	0.148	0.097	0.125	0.097	0.110
2		III	0.110	0.232	0.089	0.145	0.242	0.208	0.146	0.154	0.117	0.097	0.125	0.146
3		IV	0.146	0.208	0.232	0.089	0.148	0.148	0.154	0.205	0.110	0.117	0.097	0.090
4	1972	I	0.090	0.148	0.208	0.232	0.089	0.154	0.205	0.216	0.146	0.110	0.117	0.113
5		II	0.113	0.154	0.148	0.208	0.232	0.205	0.216	0.179	0.090	0.146	0.110	0.113
6		III	0.113	0.205	0.154	0.148	0.208	0.216	0.179	0.150	0.113	0.090	0.146	0.113
7		IV	0.113	0.216	0.205	0.154	0.148	0.179	0.150	0.192	0.113	0.113	0.090	0.113
8	1973	I	0.113	0.179	0.216	0.205	0.154	0.150	0.192	0.226	0.113	0.113	0.113	0.117
9		II	0.117	0.150	0.179	0.216	0.205	0.192	0.226	0.189	0.113	0.113	0.113	0.117
10		III	0.117	0.192	0.150	0.179	0.216	0.226	0.189	0.201	0.117	0.113	0.113	0.116
11		IV	0.116	0.226	0.192	0.150	0.179	0.189	0.201	0.198	0.117	0.117	0.113	0.135
12	1974	I	0.135	0.189	0.226	0.192	0.150	0.201	0.198	0.221	0.116	0.117	0.117	0.119
13		II	0.105	0.201	0.189	0.226	0.192	0.198	0.221	0.304	0.135	0.116	0.117	0.119
14		III	0.119	0.198	0.201	0.189	0.226	0.221	0.304	0.164	0.105	0.135	0.116	0.128
15		IV	0.128	0.221	0.198	0.201	0.189	0.304	0.164	0.203	0.119	0.105	0.135	0.234
16	1975	I	0.234	0.304	0.221	0.198	0.201	0.164	0.203	0.222	0.128	0.119	0.105	0.054
17		II	0.054	0.164	0.304	0.221	0.198	0.203	0.222	0.278	0.234	0.128	0.119	0.125
18		III	0.125	0.203	0.164	0.304	0.221	0.222	0.278	0.162	0.054	0.234	0.128	0.125
19		IV	0.125	0.222	0.203	0.164	0.304	0.278	0.162	0.250	0.125	0.054	0.234	0.163
20	1976	I	0.163	0.278	0.222	0.203	0.164	0.162	0.250	0.273	0.125	0.125	0.054	0.123
21		II	0.123	0.162	0.278	0.222	0.203	0.250	0.273	0.254	0.163	0.125	0.125	0.143
22		III	0.143	0.250	0.162	0.278	0.222	0.273	0.254	0.153	0.123	0.163	0.125	0.123
23		IV	0.123	0.273	0.250	0.162	0.278	0.254	0.153	0.309	0.143	0.123	0.163	0.156
24														

UNIVERSITY OF NIGERIA
COMPUTING CENTRE
General Purpose Coding Form

PROGRAM			PUNCHING INSTRUCTIONS	GRAPHIC		PAGE OF
PROGRAMMER	DATE			PUNCH		

				P_{t+2}	P_{t+3}	M_{2t}	M_{2t-1}	M_{2t-2}	M_{2t-3}	M_{2t+1}	M_{2t+2}	M_{2t+3}	IDENTIFICATIONS SEQUENCE
1	1977	I		0.136	0.139	0.257	0.269	0.242	0.217	0.187	0.294	0.250	
2		II		0.139	0.159	0.187	0.257	0.269	0.242	0.294	0.250	0.228	
3		III		0.159	0.151	0.294	0.187	0.257	0.269	0.250	0.228	0.239	
4		IV		0.151	0.123	0.250	0.294	0.187	0.257	0.228	0.239	0.254	
5	1978	I		0.123	0.147	0.228	0.250	0.294	0.187	0.239	0.254	0.242	
6		II		0.147	0.162	0.239	0.228	0.250	0.294	0.254	0.242	0.257	
7		III		0.162	0.148	0.254	0.239	0.228	0.250	0.242	0.257	0.308	
8		IV		0.148	0.143	0.242	0.254	0.239	0.228	0.257	0.308	0.217	
9	1979	I		0.143	0.142	0.257	0.242	0.254	0.239	0.308	0.217	0.245	
10		II		0.142	0.142	0.308	0.257	0.242	0.254	0.217	0.245	0.317	
11		III		0.142	0.145	0.217	0.308	0.257	0.242	0.245	0.317	0.194	
12		IV		0.145	0.166	0.245	0.217	0.308	0.257	0.317	0.194	0.305	
13	1980	I		0.166	0.136	0.317	0.245	0.217	0.308	0.194	0.305	0.308	
14		II		0.136	0.181	0.194	0.317	0.245	0.217	0.305	0.308	0.225	
15		III		0.181	0.154	0.305	0.194	0.317	0.245	0.308	0.225	0.262	
16		IV		0.154	0.157	0.308	0.305	0.194	0.317	0.225	0.262	0.270	
17	1981	I		0.157	0.140	0.225	0.308	0.305	0.194	0.262	0.270	0.260	
18		II		0.140	0.134	0.262	0.225	0.308	0.305	0.270	0.260	0.252	
19		III		0.134	0.169	0.270	0.262	0.225	0.308	0.260	0.252	0.269	
20		IV		0.169	0.154	0.260	0.270	0.252	0.225	0.252	0.269	0.272	
21	1982	I		0.154	0.157	0.252	0.260	0.270	0.262	0.269	0.272	0.278	
22		II		0.157	0.180	0.269	0.252	0.260	0.270	0.272	0.278	0.234	
23		III		0.180	0.170	0.272	0.269	0.252	0.260	0.278	0.234	0.301	
24		IV		0.170	0.173	0.278	0.272	0.269	0.252	0.234	0.301	0.284	

UNIVERSITY OF NIGERIA

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PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC									PAGE OF
PROGRAMMER	DATE		PUNCH									

			P_{t+2}	P_{t+3}	M_{2t}	M_{2t-1}	M_{2t-2}	M_{2t-3}	M_{2t+1}	M_{2t+2}	M_{2t+3}	IDENTIFICATIONS SEQUENCE
1	1971	II	0.146	0.090	0.142	0.164	0.189	0.233	0.202	0.221	0.174	
2		III	0.090	0.113	0.202	0.142	0.164	0.189	0.221	0.174	0.181	
3		IV	0.113	0.113	0.221	0.202	0.142	0.164	0.174	0.181	0.213	
4	1972	I	0.113	0.113	0.174	0.221	0.202	0.142	0.181	0.213	0.217	
5		IV	0.113	0.113	0.181	0.174	0.221	0.202	0.213	0.217	0.194	
6		III	0.113	0.117	0.213	0.181	0.174	0.221	0.217	0.194	0.178	
7		IV	0.117	0.117	0.217	0.213	0.181	0.174	0.194	0.178	0.201	
8	1973	I	0.117	0.116	0.194	0.217	0.213	0.181	0.178	0.201	0.226	
9		II	0.116	0.135	0.178	0.194	0.217	0.213	0.201	0.226	0.209	
10		III	0.135	0.105	0.201	0.178	0.194	0.217	0.226	0.209	0.228	
11		IV	0.105	0.119	0.226	0.201	0.178	0.194	0.209	0.228	0.225	
12	1974	I	0.119	0.128	0.209	0.226	0.201	0.178	0.228	0.225	0.223	
13		II	0.128	0.234	0.228	0.209	0.226	0.201	0.225	0.223	0.279	
14		III	0.234	0.054	0.225	0.228	0.209	0.226	0.223	0.279	0.206	
15		IV	0.054	0.125	0.223	0.225	0.228	0.209	0.279	0.206	0.226	
16	1975	I	0.125	0.125	0.279	0.223	0.225	0.228	0.206	0.226	0.247	
17		II	0.125	0.163	0.206	0.279	0.223	0.225	0.226	0.247	0.252	
18		III	0.163	0.123	0.226	0.206	0.279	0.223	0.247	0.252	0.217	
19		IV	0.123	0.143	0.247	0.226	0.206	0.279	0.252	0.217	0.242	
20	1976	I	0.143	0.123	0.252	0.247	0.226	0.206	0.217	0.242	0.269	
21		II	0.123	0.156	0.217	0.252	0.247	0.226	0.242	0.269	0.257	
22		III	0.156	0.140	0.242	0.217	0.252	0.247	0.269	0.257	0.187	
23		IV	0.140	0.136	0.269	0.242	0.217	0.252	0.257	0.187	0.294	
24												