Monetary Integration in ECOWAS and Loss of Independent Monetary Policy : A Case Study of Nigeria

by

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Dedicated to My Parents
Alhaji Umar Mandara
and
Hajja Falmata Gonibe

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ABSTRACT

The Economic community of West African States (ECOWAS) is an economic organisation among 16 countries of Africa south of the Sahara. One of the main objectives of ECOWAS is to join the member countries in a complete monetary union with a single currency and a single central bank. A major disadvantage to a country of being a member of this form of monetary cooperation is the loss of independence in carrying out monetary policy.

This study is an examination of the degree to which Nigeria is likely to lose independent monetary policy by participating in the ECOWAS monetary union. Since the monetary union is still at the proposal stage, the issue is addressed by examining the following question: Can Nigeria conduct an effective independent monetary policy by changing the quantity of the money stock in the economy?

According to the money multiplier theory of the money stock determination, successfully changing the money stock requires the following: Firstly the money multiplier should be stable and predictable, and secondly, the monetary base should be exogenously controllable. Although the money multiplier and its determinants in Nigeria are found to be stable and predictable, both closed and opened economy analyses seem to suggest that the monetary base is endogenous. Specifically, it is found to be determined by the demand for money. This implies that the monetary base and therefore, the money stock can only be changed by changing the money demand. In this case the successful conduct of monetary policy will require a stable money demand function which is significantly linked to a control variable. Various specifications showed that the Nigerian money demand function is stable. However, the only control variable - the interest rate is not significant, suggesting that it cannot be used to affect the money demand in a significant way.

These findings suggest that the Nigerian Monetary Authorities have a very limited independent monetary policy, and therefore there may be little to lose by participating in the ECOWAS monetary union.

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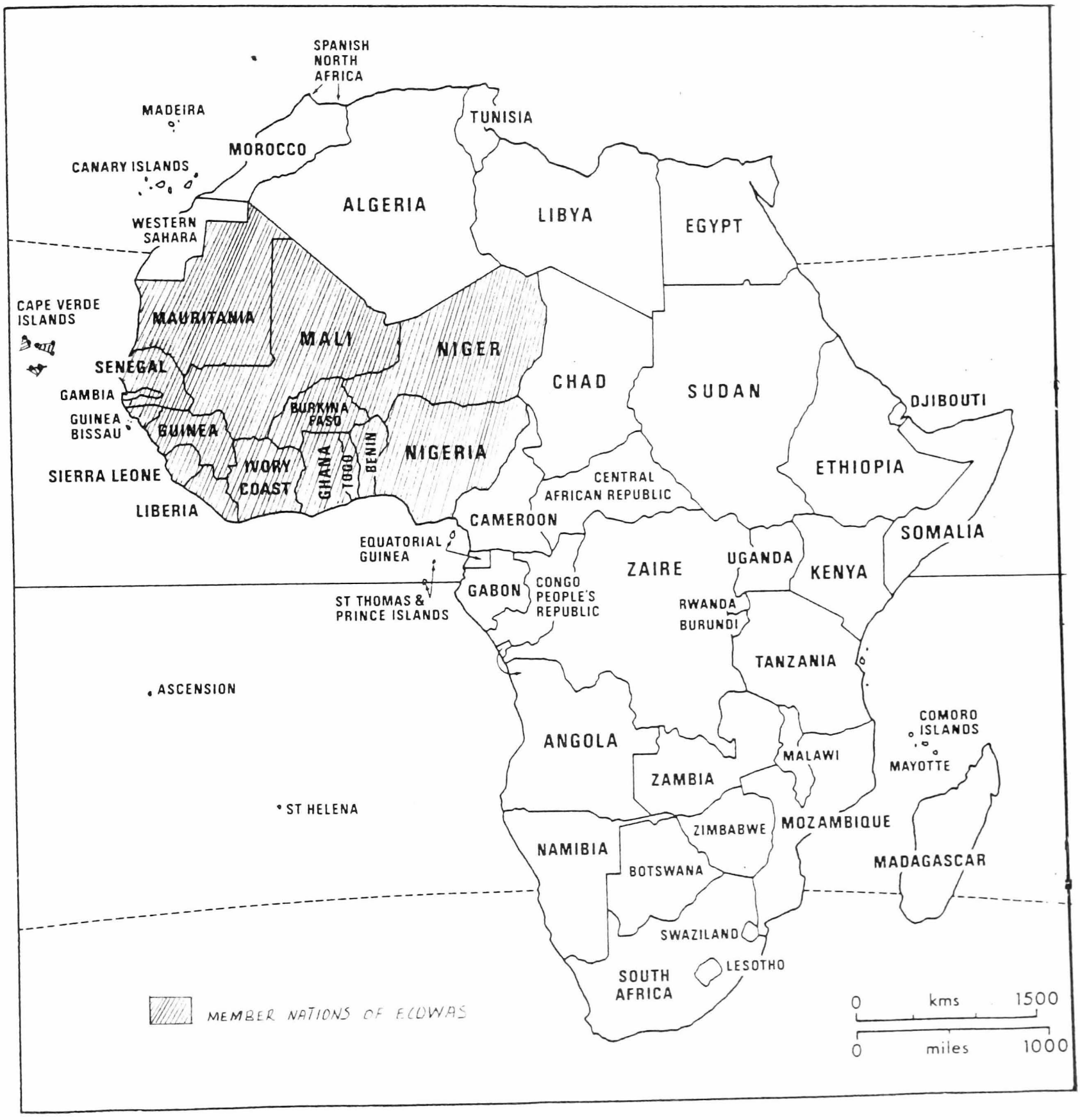
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General Introduction

The Economic Community of West African states (ECOWAS) is an economic organisation of 16 countries of Africa South of the Sahara. It formally came into existence in May 1975 when the treaty establishing it was signed by 15 of the potential member countries. The islands of Cape Verde joined in 1979, bring the total membership to the present number. The idea for forming ECOWAS was inspired by the 1965 resolution of the United Nations Commission for Africa, calling for regional economic organisations to be formed in all parts of Africa.

The goal of ECOWAS as given in the treaty and the protocols was to achieve by stages the following: 1) The elimination between member states of custom duties and similar charges 2) The abolition of non-tariff restrictions on trade among member countries 3) A common customs tariff and commercial policies towards third countries 4) Free movement between members of persons, services, and capital 5) Harmonisation of agricultural policies and promotion of common projects in member states 6) Joint development of transport, communication, energy, and other infrastructural facilities, 7) Harmonisation of economic and industrial policies of members and elimination of disparities in development 8) Harmonisation of monetary and fiscal policies, (West Africa Magazine 19th Nov. 1984). In short, the aim was to establish what Robson, 1987 refers to as an economic union among the member countries.

Although some indigenous languages are spoken across the frontiers of ECOWAS countries,[1] at present the countries use French, English, and Portuguese as their lingua franca. Nigeria, Ghana, Liberia, Sierra Leone, and The Gambia use English, Benin, Burkina Faso, Cote d'Ivoire, Guinea, Mali, Mauritania, Niger, Senegal, and Togo use

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[1] *Hausa, for example, is spoken in no less than one half of the member countries, while Yoruba, Vai, and Mandingo are each spoken in no less than three countries of the sub-region.*

French, and Cape Verde, and Guinea Bissau use Portuguese. This language-divide has been the basis for trade and other forms of relationships between countries of the sub-region since the early 1960s. For example, the French speaking countries are already members of an economic organisation (Communaute Economique de l'Afrique de l'Ouest - CEAO). In fact, seven of the French speaking countries are members of the long established monetary union (The West African Monetary Union - WAMU), with a single currency (Communaute Financiere Africaine - CFA franc) and a single central bank (Banque Centrales des Estats de l'Afrique de l'Ouest - BCEAO). The success of ECOWAS will, among many other factors, depend on overcoming this divide.

The total area of ECOWAS countries is about six million square kilometres, covering different vegetations and climatic conditions, (see map above). The northernmost countries of Mauritania, Mali, and Niger, which are also the largest countries area wise, are nearly deserts with very sparse vegetations. The middle area covering Burkina Faso, the northern part of Nigeria, The Republic of Benin, Togo, Ghana and Guinea are savannah area, while the southernmost areas are tropical rain forest. The variety of climatic conditions characterising the different areas of the sub-region ensure that ECOWAS countries are endowed with a wide variety of natural resources; ranging from diamonds and bauxite in Sierra Leone, uranium and phosphate in Niger and Senegal, to crude oil in Nigeria.

The ECOWAS sub-region is not only endowed with a rich variety of natural resources, but human resources as well. The combined population of the 16 member countries was about 190 million in 1988, with Nigeria alone accounting for about 60 percent of the total. Over 50 percent of this total population, are between the working age of 15 to 64 years old. This coupled with the sizable endowment of natural resources means ECOWAS potential, in terms of production and market, is tremendous.

According to the World Bank classification, ECOWAS countries are among the lowest income countries in the world, except possibly Cote d'Ivoire and Senegal. The

combined GDP of the ECOWAS countries in 1988 was about 62.7 billion $US, with an average GDP per capita of 331 $US. Cape Verde with 796 $US had the highest while Guinea Bissau with 143 $US had the lowest. Nigeria's GDP per-capita of 267 $US was far below the average, yet Nigeria alone accounted for over 47 percent of the total GDP of ECOWAS, (see Table A2.1).

Tables (A2.2 to A2.5) show that the legal recorded trade among the member countries of ECOWAS is very small. The total imports and exports of the ECOWAS countries in 1988 were 14.27 and 15.59 billion $US respectively. Out of this, only 7.5 percent of the imports and 6.9 percent of the exports went to member countries of ECOWAS, while 68.5 percent of the imports and 78.91 percent of the exports went to the industrial countries. In fact, by 1990 the percentage of imports and exports to/from ECOWAS to ECOWAS had declined to 7.07 and 5.7 percent. Although the percentage of imports from the industrialised countries remained almost the same, that of exports went up to 83 percent in 1990.

A number of factors account for this dismal level of intra-ECOWAS trade. Firstly, there is a high degree of non-complementarity in the production pattern of these countries. In other words, countries of the sub-region produce similar kinds of goods and therefore cannot trade with each other. For example, in 1988, agriculture, natural resources and the service sectors' contribution to GDP was over 80 percent in all the member countries of ECOWAS, while that of the manufacturing sector was less than 20 percent, (see Table A2.6). This situation can be partly explained by the fact that all countries of ECOWAS were colonies until about 30 years ago, and had their production geared towards satisfying the similar raw material needs of the different metropolitan countries. The production patterns adopted then are still in place, since as mentioned above the largest percentage of ECOWAS countries' trade is still with the former metropolitan countries.

The second impediment to intra-ECOWAS trade is the lack of adequate

transportation and communication networks, implying a large economic distance between members which reduces comparative advantage differences. Intra-regional roads in most cases are footpaths, only good for using donkeys and bicycles, while telephoning some of the member countries is only possible through a third country. The trans-ECOWAS highway project and others of similar nature are undertaken by ECOWAS with the sole intention of reducing this bottleneck.

Thirdly, the prohibitive level of tariff and other restrictions on trade with the member countries has been a major impediment to intra-ECOWAS trade. The main reason behind the setting up of the community was to remove these types of impediments. The treaty establishing ECOWAS outlined a timetable for achieving this end and therefore for the establishment of an economic union within 15 years (by 1985). The first two years (1975 - 1977) were designated as the period for consolidating all existing duties and taxes between the member countries. During this period, members were not to increase existing customs duties or taxes, nor introduce new ones. Four years after the consolidation period (by 1981) all non-tariff barriers to trade were to be eliminated. Five years after that (by 1985) all import duties between the member countries were to be eliminated and a common external tariff be mounted. However since ECOWAS did not become operational immediately after signing of the treaty, the trade liberalisation scheme was redrawn and the starting point shifted to May 1979. The revised scheme had three separate components - liberalisation of trade in unprocessed goods, in traditional handicrafts, and in industrial products.

Since unprocessed goods form the basis of the little trade going on among the countries of the sub-region, and since it is believed to constitute the main input to the young industrial sector, it was decided that all duties, taxes and non-tariff barriers to trade on these goods be eliminated by 1980. There was to be no compensation to importing countries for loss of revenue because taxes and duties paid on unprocessed goods were negligible to start with.

All import duties and taxes, and non-tariff barriers to handicraft trade were to be abolished by 1981. As in the case of the unprocessed goods, no compensation was to be provided to importing countries for any loss of revenue. Handicraft industry was looked upon by the community as an effective base for developing manufacturing skills, (ECOWAS Secretariat, 1985).

On Industrial products, the decision was to simply move the commencing date for the trade liberalisation programme from 1975 to 1979. By the end of 1982, there was no visible achievement recorded in the community's trade liberalisation programme. The main problem was the lack of a clear cut definition of a community product. The decision stated that for a product to qualify for community product status, it must be produced by an enterprise possessing an "acceptable level" of indigenous ownership. As a result of this problem, Nigeria, for example, refused to open its market to manufactured goods of French owned companies in Cote D'Ivoire.

In May 1983, a definite stand was taken on this issue. It was agreed that the minimum desirable level of national participation in the equity capital of industrial enterprise whose products were to benefit from preferential taxation, was to be realised gradually. As from May 1983, at least 20 percent indigenous capital ownership was required: by May 1986, 40 percent and by May 1989, 51 percent. The Authority also decided that for the trade liberalisation programme to succeed, a common customs nomenclature, and a common customs and statistical standards for all countries of the organisation were required. Accordingly, a year later (in 1984) a common customs declaration form for use in all member states was adopted.

For the purpose of dismantling tariff barriers, countries of the community were classified into three groups, according to their income, and industrial products into priority and non-priority products. The countries in group one (Cape Verde, The Gambia, Guinea Bissau, Burkina Faso, Mali, Mauritania, and Niger) believed to be the least prosperous, have 8 years to eliminate all tariff barriers on priority products and 10 years

on non-priority ones. The second group of countries (Benin, Guinea, Liberia, Sierra Leone, and Togo) have 6 and 8 years for priority and non-priority products. The last group of countries (Cote d'Ivoire, Ghana, Nigeria, and Senegal), believed to be the most prosperous, have 4 and 6 years to eliminate tariff on priority and non-priority products. The elimination was to start at the same time (on the 28th May 1983) in all the member countries. In the interim period, member countries were to be compensated for revenue losses incurred as a result of the elimination of tariff on originating industrial products.

Although the official recorded trade among the member countries is very small, the amount of unrecorded underground trade that exists is believed to be quite substantial. This type of trade predates the present boundaries. For example, as far back as the 17th century, traders in Katsina, now northern Nigeria, were known to have been taking donkey loads of tobacco to the present day Niger, and using the proceeds to take stock down to what is now southern Nigeria, and buying kola nuts to take back to the north, (West Africa Magazine, June 30, 1975). The present day boundaries set up during the colonial era are to a large extent, ignored and traditional trade (now classified as illegal underground trade) actively goes on across the frontiers. A successful economic integration in that region could therefore be built upon these traditional trade links

Another major impediment to intra-ECOWAS trade is the existence of so many non-convertible currencies in the region. At present there are 11 different currencies in the community. As mentioned earlier, seven of the member states (Benin, Burkina Faso, Cote d'Ivoire, Niger, Mali, Senegal and Togo) have a single currency called the CFA franc and have a single central bank (BEAO). An arrangement with France guarantees the convertibility of this currency. The arrangement is such that BCEAO is to keep the pooled foreign exchange reserves of the member countries in the French Treasury in an account known as "the operation account". The member countries of WAMU have no payments impediments regarding trade with each other. Although the CFA francs issued to the different member countries are, for accounting purposes, differentiated by a letter

at the beginning of the numbers on each currency note, all CFA francs have the same value and are fully acceptable in all member countries. The fact that most of the intra-ECOWAS trade is between the member countries of WAMU may point to the importance of the ease with which payments for trade can be made.

All payments and receipts for trade with non-operation account countries, which include the other member nations of ECOWAS are carried out through France, with the French franc serving as vehicle currency. The official exchange rates between the CFA franc and the French franc is fixed at 50 CFA to 1 French franc. The exchange rate for all other currencies are arrived at by using the rate quoted in the Paris exchange market for the currency concerned, and the fixed rate between the CFA franc and the French franc. For example, in 1980, the average rate for the Nigerian naira in terms of the French franc was 0.756 franc for 1 naira. The official exchange rate for naira in terms of the CFA franc was therefore, 37.80 (50 x 0.756) CFA for 1 naira. An importer from Nigeria would have to exchange the naira into French francs and then to CFA francs before effecting payments for transactions with any member country of WAMU. All other currencies in the region, except the Liberian dollar, are completely non-convertible, and all transactions would have to be carried out using a third currency.

To alleviate this particular bottleneck to intra-community trade, ECOWAS has in the short-run sought to establish a clearing house where payments between member countries can be settled, and in the long-run to form a complete monetary union. Accordingly the West African Clearing House (WACH) was established and started operation in July, 1976, (Osagie, 1979). All current account transactions, except purchases of oil from Nigeria and payments for goods originating from a third country can be settled through the WACH.

The clearing mechanism in WACH is similar to clearing transactions by a national central bank of cheques submitted by commercial banks. WACH acts like a central bank, while the national central banks take on the role of commercial banks. All transactions

would have to go through a commercial bank and a national central bank. If, for example, a business man in Nigeria purchases some goods from a firm in Ghana, he would first of all direct his commercial bank to make the payment. The commercial bank in Nigeria would pay to the Central Bank of Nigeria the amount in naira. The Nigerian Central Bank will notify its counterpart in Ghana, and the Clearing House, where the account of the Nigerian Central Bank is debited while that of the Central Bank of Ghana is credited by that amount. The Clearing House will also, in its own right, inform the Ghanian Central Bank of the transaction. The Central Bank of Ghana will then credit the account of the exporter firm's commercial bank, and the commercial bank will credit the exporter firm's account in Ghanian currency. At the end of every month, the Clearing House would tally up the balances of each member state and debit balances are then settled.

Although the final balances with the clearing house can be settled in pounds sterling, French francs, US dollars, Swiss franc or Deutschmarks, they are recorded in a numeraire unit called the West African Unit of Account (WAUA), whose value is fixed at par with the IMF's Special Drawing Rights (SDR). This helps to protect the values of monetary claims and payments from exchange rate changes that might arise if any single currency were used. The SDR and by definition the WAUA is measured in terms of a basket of currency rather than any single currencies.

After the difficulties of the formative years, the West African Clearing House took off modestly. In the year 1982/83, 158.31 million WAUA worth of transactions went through it. The value of transaction reached its peak in 1983/1984 with an amount of 224.40 million WAUA. Since then this value has been declining, such that in the year 1988/1989 only 28.22 million WAUA worth of transactions passed through it. The main problem has been the delay in settling the debit balances. For example, by the end of 1982, the total accumulated debt was 9.2 million WAUA (about 10 million US dollars). By the end of 1985, the debt position had worsened to 50.1 million WAUA (about 55

million US dollars), with the oldest debt recorded, about 40 months in arrears. There are three main reasons for this problem; Firstly, commercial banks, through which the clearing mechanism begins and ends, often failed to demonstrate adequate grasp of the mechanism. Secondly, Central Banks in the sub-region have suffered acute foreign exchange shortages due to deteriorations in their external earnings, and therefore could not undertake settlements as and when due. Lastly, WACH itself has had difficulties notifying national central banks of their debtor/creditor positions, thus causing the balances to build up.

As mentioned earlier, WACH is only an interim measure. In addition to its dismal performance so far, WACH has not totally eliminated the use of hard currencies for intra-ECOWAS trade. ECOWAS has a monetary cooperation programme which ultimately intends to establish a single currency and a single central bank for all the member countries.

The legal bases of the ECOWAS monetary cooperation programme are Articles 2(h) and and 36 1(b) of the treaty. These articles stipulate the pursuit of harmonisation of the monetary policies of the member states as soon as possible. The programme however, did not take a definite shape until May 1987. Studies commissioned by the community established that the idea of a single monetary zone in the sub-region is desirable and feasible. It suggested that the ideal system is the one that operates among the seven WAMU countries, who are also members of ECOWAS. In other words, the ideal system is a single currency with a single central bank for all the 16 member countries. This was supposed to be achieved in three phases. The first phase, which was expected to last four years (1986 - 1989), was to be the adjustment phase, where exchange rates, credit and fiscal policies of the member countries were to be harmonised under the supervision of a coordinating committee. Based on a successful completion of the first phase, the second phase (1989 - 1990) was expected to see the setting up of functional structures, and the last phase (1991 - 1992) would see the replacement of the

national currencies by a common one and turning of national central banks into branches of the ECOWAS wide central bank. Except for the monetary reforms undertaken by individual member countries as part of structural adjustment sweeping across developing countries all over the world, there has not been any visible signs of progress. However, these reforms have led to a greater harmonisation of exchange rates of the member nations that the the Executive secretary of ECOWAS believes that *"it is now easier for the member countries to adopt fiscal and supply side measures to sustain and strengthen the monetary situation and lead to the creation of a single monetary zone"* (West Africa Weekly Magazine, 28th May - 3rd June, 1990).

The issue of monetary cooperation has occupied a place of prominence in discussions among not only the member countries of ECOWAS, but of many other regional economic organisations all over the world. In Europe, monetary union is occupying centre stage in discussions among the member countries of the EEC. For the South East Asian organisation, a study by Dodsworth and Diamond (1980) suggested that it could be beneficial for countries of the region to have a monetary cooperation programme. In the Middle East, the Gulf Cooperation Council (GCC) is also discussing monetary cooperation among the member countries.

The theoretical approach to the issue of monetary cooperation among nations is divided into two. The traditional approach, dubbed as the "theory of optimum currency areas" bases the desirability of a country or a region taking part in a monetary cooperation programme (defined in terms of having their exchange rates fixed to each others) on the effect it will have on standard objectives of full employment, price stability and balance of payments equilibrium. According to the pioneering work of Mundell (1961), the single criterion for a group of regions or group of countries to have their exchange rates fixed to each others is the degree of factor mobility within the group. If factors of production are highly mobile, it is possible for the standard objectives to be attained under a fixed exchange rate regime.

McKinnon (1963) is of the view that the appropriate criterion is the degree of openness of the economies of prospective member nations. To him openness is defined in terms of the ratio of tradable goods and services (importables and exportables) to non-tradable ones. The more open is the economy, the less effective it would be to use the exchange rate as a tool for correcting external imbalance. He argued that using the exchange rate may in fact lead to an instability of domestic prices. A group of regions or countries that are highly open, according to the above definition of openness, would do better to fix their exchange rates and use monetary and fiscal policies to correct any external imbalances.

According to Kenen (1969), the degree of product diversification should be the best criterion. A country or region that produces a large number of different kinds of products can afford to have its exchange rate fixed and thus be a member of a currency area. The rationale is that change in the external demand of one of the many products of this country will have a lesser effect on unemployment than if the country were a monoproduct country. Countries or regions that produce a variety of products should therefore come together to form a currency area, while mono-product countries should be currency areas themselves and have a flexible exchange rate with the rest of the world.

Other criteria put forward include a degree of financial integration, similarity in the rates of inflation, and a high degree of policy integration, etc. (see Ishiyama, 1975 for a survey).

The alternative approach to the question of which countries or regions should join in a monetary union does not concentrate on a single criterion. Instead, it evaluates a whole range of costs and benefits to a country, and weighs one against the other. If the benefits are found to be more than the costs, a country should join the monetary union, and vice versa.

Although the theory of optimum currency areas is defined in terms of countries having their exchange rates permanently fixed to each other, monetary cooperation

among nations may take other forms. The ultimate monetary cooperation entails the establishment of a single central bank, which issues one currency for all the member nations, coordinates their monetary policy and pools their foreign exchange reserves (the proposed ECOWAS type). Some of the likely benefits of this kind of monetary cooperation are as follows: Firstly, a common currency, especially in a group of developing countries will be more stable than an individual country's currency. This is partly because a single member country cannot unilaterally act in a manner that will affect the value, and partly because internal and external shocks would be spread across the member countries. Eitherway, this stability is likely to improve the investment climate and thus encourage investments (especially foreign investments) in the region. Secondly, risk of exchange rate variation that is likely to exist if member countries have different currencies will be eliminated, thus promoting intra-regional trade. Thirdly, it is likely to lead to foreign reserves savings. Countries do not have to use foreign currency for intra-regional trade, thus reducing the needs for its use. This also encourages intra-regional trade. This is particularly important for developing countries who are usually faced with a chronic shortage of foreign exchange reserves. Furthermore, having one central bank with pooled reserves means individual countries could dispense with institutions whose sole function is to manage foreign exchange, and divert the resources elsewhere.

Although there are some benefits to a country in becoming a member of the above type of monetary cooperation programme, there are also some offsetting costs associated with it. The most obvious of these costs is the loss of autonomy in the pursuit of independent national macroeconomic policies; specifically, monetary, fiscal and exchange rate policies. The quantity of money to be supplied each period is determined through some collective decision making body like a union-wide central bank. National governments virtually surrender the power to alter the money supply when and as they see fit. This implies that sudden shocks to the economy cannot be responded to

immediately, as the union-wide decision making body may only meet at certain fixed intervals, e.g yearly, or quarterly. In addition to the constraint on independent monetary policy, there also might be limitations on some aspect of fiscal policies. For example, it is highly likely for government deficit financing through the central bank to be fixed by the union-wide monetary authority. This constraint will be most serious for developing countries where, a large percentage of government deficits are financed through borrowing from the central bank. Even if a looser kind of monetary cooperation is envisaged, a meaningful cooperation will at least require that exchange rates of the member countries be permanently fixed to each other. As in the cases of the monetary and fiscal policies, decisions to change the exchange rate can only be taken collectively. The exchange rate as a tool, for example to improve competitiveness, is no longer available to the individual member nations.

Another cost is that this type of monetary union is likely to enhance rather than reduce imbalances between member countries. It is likely for the capital markets to be integrated, such that capital is absolutely free to move from one member country to another. However, if there is a differential in the rate at which member countries grow, capital will be attracted away from slow growing countries to fast growing countries because the unit labour cost in the latter is likely to be lower. This will worsen unemployment in the slow growing countries. In the context of developing countries, capital and investment could be attracted to the more developed member countries because there may be more advanced infrastructure and other industries that provide linkages and external economies. These more developed member countries will then become the poles of growth at the expense of the least developed ones.

In this study, one of the likely costs of the ECOWAS monetary cooperation programme for Nigeria will be investigated. Specifically, the degree to which Nigeria is likely to lose the ability to conduct an independent monetary policy will be examined. Since the monetary cooperation programme is still at the proposal stage, the issue will be

handled in an indirect manner, by addressing the following question: Are the Nigerian Monetary Authorities able to conduct an independent monetary policy at present or in the past? A negative answer to the above question means that the cost associated with the loss of monetary policy independence will be negligible since it never had any to start with. Being a pioneering one, this study is not expected to give a conclusive answer to the vital question of whether Nigeria should be a part of the ECOWAS monetary union. To answer that, the other likely costs plus the likely benefits of Nigeria's membership would have to be evaluated and weighed.

The study is organised in six chapters. In chapter 1 a review of the Nigerian financial sector is presented with the aim of providing necessary background information for the subsequent chapters. Specifically, the historical developments of the Central Bank of Nigeria (CBN), and its function as the main agent of monetary policy and fiscal policy is analysed. The implications of the ECOWAS monetary integration with respect to these vital functions are also examined. The commercial banks and their importance as agents of monetary and fiscal policies are also briefly considered. Further, the developments of the Nigerian money market and the capital market are also reviewed. The historical development of exchange controls in Nigeria coupled with some ingenious ways adopted to achieve a realistic level of the exchange rate for the Nigerian naira are also analysed.

The aim of chapter 2 is to investigate econometrically the stability and predictability of the Nigerian money multiplier. According to the money multiplier/monetary base theory of money supply determination, for a given, stable and predictable money multiplier, the monetary base can be altered to achieve a certain level of desired money stock in the economy. If the money multiplier is not stable and predictable, it is impossible for the Nigerian monetary authorities to be certain of the value the money stock is ultimately to take when the monetary base is altered. In this case the monetary authorities would not be able control the money stock and may not have any independent

monetary policy. It is the belief of this study that it is not enough to simply observe the year to year fluctuations of the money multiplier and come to a conclusion about its stability or lack of it. In Nigeria there have been various kinds of internal and external shocks which affected the money multiplier. Instead, the money multiplier and its components (currency and reserve ratios) will be modelled econometrically and the empirical models used to investigate the ease with which future values of these variables can be predicted. Approaching the issue in this manner, shocks and regime shifts to the economy can be handled by the use of dummy variables.

The main premise behind the analyses of chapter 2 is that the monetary base can be exogenously controlled by the monetary authorities, which in fact may not be true. This issue, and critique of the money multiplier approach as a theory of money supply determination is developed in chapter 3. It has been argued that the money multiplier approach is deficient because the basic money stock equation is nothing more than an identity. As an identity, it lacks the behavioural content to be a theory. A model for money stock determination should be broad enough to take into account explicitly the behaviour of all the participating agents. In other words, money should be treated as one of many assets in the portfolio of an economic agent. With regard to the monetary base, Post Keynesians argue that it is endogenous and not exogenous. The monetary base, defined to be equal to the currency in circulation plus the reserves of the commercial banks, changes in direct response to changes in the demand for credit. An increase in credit demand leads to an increase in credit, and thus deposits. A component of all deposits would have to be held as reserves, thus increasing the banks' reserves and the monetary base. It is the increase in money (deposits) which leads to an increase in the monetary base and not the other way round. According to this line of reasoning, central banks can neither control the monetary base nor the money stock.

One way of putting the Post Keynesians' proposition to an empirical test is for the direction of causality between domestic credit and the money stock on the one hand, and

the money stock and the monetary base on the other hand, to be determined. Causality running from domestic credit to money, then from money to the monetary base indicates that the monetary base and the money stock are endogenous. The Granger-Sims causality test is used to determine whether the Nigerian monetary base and the money stock are in fact endogenous as postulated by the Post Keynesians. If the monetary base is endogenous, even if the money multiplier were stable and predictable, the money stock cannot be controlled by the Central Bank of Nigeria. The only way the money stock can be changed for monetary policy purposes is to change the demand for it, or use direct credit control.

Controlling the money stock by changing the demand for it will require a stable demand function which is significantly linked to the control variable. The issue of stability of the Nigerian money demand function is taken up in chapter 4. Three separate specifications of the money demand function (partial adjustment, levels and changes, and error-correction and cointegration) will be estimated using the Nigerian data.

Chapters 5 and 6 introduce open economy elements. So far the monetary base is looked at through the liability side of the central bank's balance sheet. Using the assets side the monetary base can be defined as the sum of net foreign and the net domestic assets of the central bank. The central bank cannot change the monetary base through the foreign assets component because the foreign assets (mainly the foreign exchange reserves), are determined by external conditions. Any change in the monetary base can only arise by changing the domestic component. According to the monetary approach to the balance of payments theory, a sustained change in the monetary base is impossible because any change in the domestic component is offset by an equal but opposite change in the foreign component. This would seem to suggest that the monetary base is endogenous and cannot be controlled by the central bank.

Chapter 5 critically assesses the monetary approach to the balance of payments theory. It also derives and discusses the equation often estimated to measure the degree

of offset to the domestic component of the monetary base by the foreign component (reserves flow equation). One of the major assumptions behind the monetary approach theory is that countries do not sterilise balance of payments deficits and surpluses. The equation used to test this contention - monetary policy reaction function - is also derived and discussed. Furthermore, a theoretical possibility of reconciling the monetary approach and the Keynesian approach to the balance of payments is explored.

Criticisms of the reserves flow equation include the fact that it is derived from the money market conditions alone, to the exclusion of all other sectors of the economy, and the fact that it is a long-run analysis where the domestic prices, interest rates and income are assumed to be optimally given. In chapter 6, the offset coefficient is derived in the context of a macro-model which includes not only the money market, but goods market and the external sector of the economy. Furthermore, domestic prices, income and interest rates are allowed to change, and thus effectively give the offset coefficient in the short-run. In the second part of the chapter, the reserve flow equation, the equation derived from the macro-model, the monetary policy reaction functions plus an exchange rate change reaction function will be estimated with a view to measuring the offset coefficient for Nigeria. An offset coefficient value of minus one means that the monetary base in Nigeria is endogenous and therefore, cannot be controlled by the Central Bank.

The overall summary and conclusion of the findings are then presented. Two appendices, one for the data used and the other for some basic ECOWAS statistics are presented.

Chapter 1

A Review of the Nigerian Financial Sector

1.1 Introduction

The Nigerian financial sector is the most developed in ECOWAS. It has had a functioning central bank since 1959. Like any other modern central bank, the Central Bank of Nigeria performs the traditional function of being the guardian of the financial system of the country. Its primary function however is that of planning and executing monetary policy. Of the many tools of monetary policy open to the Central Bank of Nigeria, only a few have been used effectively. Open market operations have never been used in the country. The liquidity and other ratios have been used but not effectively, because the actual observed ratios have always been higher than the prescribed ones. The most often utilised tool is the sectoral and overall credit control. Every year the Central Bank directs commercial banks and other financial institutions, as to the total percentage of credit expansion and the distribution of this credit to the different sectors of the economy. Besides the primary function, the Central Bank of Nigeria has been a vehicle for Government deficit financing since its establishment.

Nigeria also has a fair number of commercial banks, both domestic and foreign owned. There is also a functioning money market since 1960. Both the volume and the value of instruments traded in the money market have grown tremendously.

One of the two organised stock exchanges in the region is in Nigeria. The Nigerian Stock Exchange was set up in 1961 and since then it has expanded its trading in both government and private stocks and shares, especially since the oil boom of the early 1970s. There is every possibility for the Nigerian Stock Exchange to be a centre for all ECOWAS, when the ECOWAS monetary integration programme takes off. The other

stock exchange which is in Cote d'Ivoire, was established in 1976, and it is at a rudimentary stage of development compared to the one in Nigeria.

The objective of this chapter is to provide background information for the rest of the thesis. Hence, it is descriptive and concentrates on the institutional details.[1] The remainder of the chapter is organised as follows: In section 1.2 a discussion about the historical development of the Central Bank of Nigeria, and its functions, with a special emphasis on that of being an agent for monetary and fiscal policy is carried out. Section 1.3 looks at the development of commercial and other banking activities in the country, while section 1.4 deals with the money market; and section 1.5 concentrates on the Nigerian capital market. The historical development of the exchange control measures in Nigeria, coupled with some new developments in the foreign exchange market are examined in section 1.6. Section 1.7 presents a summary and conclusion to the chapter.

1.2 The Central Bank of Nigeria (CBN)

The beginning of central banking in Nigeria, and the whole of the former British West Africa, dates back to the era of the West African Currency Board (WACB), first formed in 1912. The WACB was not a central bank in the modern sense of the word. It issued currency and exchanged domestic currency for foreign currency (pound sterling) when the need arose. It did not have the power to carry out independent monetary policy. Money supply went up or down in accordance with changes in the foreign reserves position of the country. This meant that the money supply went up automatically in years of good exports and vice-versa.

A functional central bank (the Central Bank of Nigeria - hereafter referred to as the CBN) was established by the Central Bank Ordinance of 1958, and became operational in July 1959. Functions of the bank, as stated in the ordinance, are to issue currency in Nigeria, to maintain external reserves in order to safeguard the international value of the

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[1] *For a comprehensive discussion of the Nigerian financial system see Nwankwo, 1980.*

Nigerian currency, to promote monetary stability and a sound financial structure for Nigeria, and to act as a banker and adviser to the Federal Government of Nigeria, (CBN Economic & Financial Review, June 1979).

The CBN is fully owned by the Nigerian Government, who appoints the Governor and the members of the Board of Directors. At present, the Bank is organised into four main sections - The Governors/Deputy Governor's office, Monetary and Banking policy, Operations, and Management and Staff Services. Under each section are departments headed by a head of department or its equivalent. As of December 1987 there were 27 departments and autonomous units.

The primary function of the Central Bank of Nigeria (CBN), like any other modern central bank, is the formulation and execution of the country's monetary policy. The objective of monetary policy in Nigeria is to achieve the following: a real growth of the economy, stable prices, and a healthy balance of payments. The starting point of formulating monetary policy in Nigeria, is for the CBN to carry out a general review of the existing economic and financial condition of the country. The next step is for it to design the future course of the economy. The CBN would then submit the design of the future course of the economy, the policy objectives of the design, and the monetary policy tools that can be used to achieve the policy objectives, to the Federal Government as a proposal. The Government after consultations with the relevant ministries, releases the Central Bank proposal as a monetary policy circular. The CBN then sends the circular to the financial institutions. A typical monetary policy circular issued, would contain the amount of bank credit expansion and the sectoral distribution of that credit for that year. It would also contain the interest rate structure for the economy, and the required minimum cash and liquidity ratios.

Although all the modern tools of monetary policy are open to the CBN, it has so far used only a few. Open market operations in the traditional sense of the term - buying and selling government securities, with the sole intention of enhancing or reducing the

abilities of the financial institutions to extend credit has never been undertaken in Nigeria. This is partly because of the narrowness (perceived or real) of the Nigerian money market, but most importantly, because of the effect it will have on the interest rate and thus the cost of government borrowing and deficit financing.

The Central Bank of Nigeria has the power not only to set the required liquidity ratio for all commercial banks, but also to define and vary what constitute a liquid asset. The Central Bank can also set different liquidity ratios for different types of deposits and for different banks. The liquidity ratio was first set in 1958 at 30 percent, but later in 1962 reduced to 25 percent. It remained at that level until 1987 when it was raised to 30 percent again. Furthermore, the ratios were the same for all banks and all types of accounts. The required liquidity ratio in Nigeria has been an ineffective tool of monetary restraint. In addition to the fact it has been virtually fixed at the same level since its inception, the actual liquidity ratios of the banks have always been greater than the prescribed ones.

The Central Bank of Nigeria is also empowered, for the purpose of maintaining monetary stability of the economy, to issue, place, sell, repurchase, amortise or redeem securities known as the stabilisation security. It can issue and sell this security to any commercial bank or financial institution it deems fit. This instrument was used for the first time in 1976 to control the inflationary pressures arising from the rapid expansion in the commercial banks liquidity brought about by the increase in oil revenue in Nigeria.

The Central Bank can also use variables that affect the cost of money. Specifically, it can control the minimum rediscount rate which is linked to the commercial banks' savings and lending rates. Unlike the other tools, the Central Bank has been actively using the discount rate for monetary policy purposes since 1962. The discount rate was first changed in 1963 - reducing it by 0.5 percent to 4 percent. In December 1964, it was raised to 5 percent and in May 1968 it was reduced to 4.5 percent. The discount rate remained at that level until April 1975 when it was further reduced to 3.5. However, in

the face of the inflationary pressure caused by the monetisation of the Government's oil revenue, the rate was raised to 4 percent in April 1977, and then to 5 percent in 1978/79. Since then the discount rate has been continuously rising, such that by 1987 it has reached 15 percent. Prior to 1987, not only did the Central Bank control the discount rate, but all other interest rates as well. However, since 1987 it only fixes the discount rate to indicate the desired direction of change in all other interest rates. These frequent fixings of the interest rates seem to indicate that Nigeria, for monetary policy purposes, targets the interest rate and allows the monetary base to adjust.

The most widely used tool for monetary policy purposes is credit controls. The CBN, in addition to setting a ceiling on aggregate credit expansion for the economy, also issues directives to financial institutions to allocate a certain percentage of the total credit in any given year to a certain specific sector. The attractiveness of this tool, unlike the other tools, lies in its ability to affect the money stock directly. For the purpose of credit allocation, the economy is divided into preferred and less preferred sectors. The preferred sector, includes agriculture, small scale industries, etc. The ceiling on total bank credit expansion to the private sector in 1985 was 7.0 percent; of which 75 percent was to go to the preferred sector, and 25 percent to the less preferred sector. The actual increase in bank credit achieved for that year was 5.5 percent, 1.5 percent short of the ceiling. Allocation to the preferred sector also fell short of the guide line by 6.8 percent.

As far as these standard tools of monetary policy are concerned, they are either never used by the Central Bank, or where an attempt has been made, they resulted in a minimal level of success. This may mean that there is very little to lose by surrendering their use to an ECOWAS-wide Central Bank.

Besides the traditional function of formulating and executing monetary policy, the Nigerian Central Bank has been a major source of government deficit finance. The CBN acts as a vehicle for government deficit finance, firstly by organising and issuing debt instruments like the Treasury Bills, Treasury Certificates, etc. and secondly by

purchasing some of the debt instruments issued. Quite often the Central Bank ends up buying the largest percentage of the debt instruments issued. For example, out of the 111.15 billion naira worth of treasury bills issued in 1988, the Central Bank purchased over 80 percent (89.02 billion naira). The total treasury certificate issued that year was about 6.5 billion naira; out of which the Central Bank purchased about 69 percent (4.74 billion naira) of this total. Furthermore, as shown in Table 1.1 below, nearly 50 percent of the total Government domestic debt outstanding, since 1980, was owed to the Central Bank. Of all the functions of the Central Bank of Nigeria, that is likely to be lost in the event of the ECOWAS monetary union, it is the loss of this particular one that may cause the most concern to the Government of Nigeria. However, this may not be entirely a bad thing, since it is likely to instill some discipline into the government deficit spending in a manner not possible for the Central Bank of Nigeria.

Table 1.1

Holdings of the Fed. Gov. Domestic Debt (Millions of naira)									
Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Central Bank	2859.2	6046.6	8022.5	11347.4	10701.4	11521.9	17721.6	19163.6	28353.9
Comm. Banks	2978.9	2135.2	3168.5	5459.7	8998.2	10669.1	4968.3	8219.8	6774.6
Merchant Banks	60.1	70.9	176.6	388.8	895.0	1165.1	159.9	290.5	243.0
Non-Bank Public	2020.2	3192.2	3479.9	5028.4	5080.4	4595.9	5601.4	9126.7	11659.6
Total	7918.4	11444.9	14847.5	22224.3	25675	27952	28451.2	36800.6	47031.1

Sources: CBN Economic and Financial Review

1.3 Commercial Banking

The first commercial bank in Nigeria, and indeed in all of the former British West Africa, was the West African Banking Corporation (WABC) which started operation in Nigeria in 1891. This bank, besides providing normal banking services to the expatriate traders, was also the sole importer of the British coins into West Africa. It carried out this function until the formation of the West African Currency Board in 1912.

The West African Banking Corporation (WABC) changed its name to the Bank of British West Africa (BBWA) in 1893, to the Bank of West Africa (BWA) in 1957, the

Standard Bank of Nigeria in 1969, and the First Bank of Nigeria in 1979. The second commercial bank to be established in the region was Barclays Bank DCO. This bank, formed in 1926, had branches in Nigeria, Ghana, Sierra Leone and Gambia. In Nigeria, the name of the Bank was changed to the Union Bank in 1979. The third major bank was the United Bank of Africa (UBA) established after World War II. These pioneer commercial banks in Nigeria were completely foreign owned with lending practices that were discriminatory against indigenous businessmen. Indigenous banks became a necessity to cater for the rapidly growing indigenous business class. The first indigenous bank in Nigeria was the short-lived Industrial and Commercial Bank which was established in 1924 and went bankrupt 6 years later in 1930. The indigenous commercial banks that survived till today include The National Bank of Nigeria established in 1933, The Wema Bank established in 1945, and the African Continental Bank established in 1948. By the end of 1950 there were seven established commercial banks operating in Nigeria. By 1963 the number of commercial banks (foreign owned, indigenous, and mixed) has risen to 16 (Brown, 1966). At the end of 1980, there were 20 commercial banks with 740 branches operating all over the country. By 1987, the number of commercial banks has increased by more than 50 percent to 33, while that of the branches has gone up by more than 100 percent to 1,483. The total assets of the commercial banks have also risen from about 434 million naira in 1965, to over 64 billion naira by the end of 1989, (see Table 1.2).

Table 1.2

Total Assets/Liabilities (Millions of naira - End of Period)						
Year Ending	1965	1970	1975	1980	1985	1989
Central Bank	239.08	452.33	4,104.40	9,357.4	15,727.6	91,903
Commercial Banks	434.28	1,152.04	4,308.00	16,340.5	31,997.9	64,874.20

Sources: CBN Economic and Financial Review (Various Issues)

In addition to their regular functions, the commercial banks in Nigeria play a very important role in the financing of the Federal Government deficits. A large percentage of

government bonds issued are subscribed to by the commercial banks. For example, in any given year between 1980 and 1987, the non-bank public subscribed to less than 10 percent of the treasury bills issue. The remaining 90 percent was shared between the Central Bank and the commercial banks. The percentage of the yearly issues purchased by the commercial banks varied from year to year. In 1980 the commercial banks purchased 70.6 percent of the total issue, while in 1987, only 18.7 percent of the total issue was purchased by the commercial banks, (CBN Annual Report and Statement of Accounts, various issues). The decline in the share of government securities purchased by the commercial banks during the late 1980s is due to the liquidity squeeze they experienced, brought about by the tight money policy of the government to control inflation. The extent to which commercial banks are involved in government deficit financing can also be seen from the amount of the total government debts owed to them since 1980, (see Table 1.1 above).

Merchant banking in Nigeria also grew from 6 with 12 branches in 1980 to 16 with 33 branches in 1987. By the end of 1987, total merchant banks' assets/liabilities stood at about 12.3 billion naira. There are also 4 specialised development banks (Nigerian Industrial Development Bank (NIDB), Nigerian Bank of Commerce and Industry (NBCI), Nigerian Agricultural Co-operative Bank (NACB), and the Federal Mortgage Bank of Nigeria (FMBN)). All 4 development banks are fully owned by the government. Their assets/liabilities as at the end of 1987 were 852.9, 406.8, 550.2 and 584.3 million naira respectively. The Nigerian Financial market also has 87 registered insurance companies.

Despite the number of commercial banks and branches operating in Nigeria at the moment, the country is still considered to be under-banked, compared to the industrial countries of the West. As at the end of 1980, the ratio of bank branches to the population in Nigeria was about 1 to 1 million people. The number for the UK was 1 to 4000, while that of the US was 1 to 6000. At present indigenous banks do not operate in the different

member countries of ECOWAS. Regulations about establishing and running a bank differ across the member countries. The ECOWAS monetary integration programme is likely to harmonise all rules relating to banking activities and expand the prospects for Nigerian indigenous banks to open branches in the other member countries. This may also enhance the trade within the region, since it is easier for transactions to be carried out through branches of the same bank than otherwise.

1.4 The Money Market

The legal starting point of the Nigerian money market was the Treasury Bills Ordinance of 1959. This Ordinance empowered the Nigerian government to borrow money by issuing treasury bills (TBs) through the CBN. The CBN designed and issued the first TBs for 4 million Nigerian pounds in April 1960. At the initial stage the TBs issue was restricted to 10 percent of the estimated revenue of the Federal Government during the year. As time went on, this limit was relaxed. In 1961 it was increased to 20 percent of the expected revenue, and then to 40 percent in 1962, to 50 percent in 1963, to 100 percent in 1969, and to 150 percent in 1971. Due to the continuous over-subscription of the Treasury Bills, another short-term money market instrument (Treasury Certificate) was introduced to the Nigerian money market in 1968. In April 1975 three more instruments were introduced, with the aim of creating an additional investment outlet for the Commercial banks.

i Certificate of Deposits:- This is basically an inter-bank debt instrument to provide avenues for commercial banks to deploy their short-term surplus funds in a readily marketable instrument. It was also expected to create sources of funds for the issuing houses, such as the merchant banks. The negotiable certificate of deposits have a maturity range of between 3 and 36 months. If a certificate of deposit is of less than 18 months maturity, it is treated as a demand liability, and also classified as a liquid asset which is rediscountable at the CBN.

ii Bankers Unit Fund (BUF):- This instrument is indirectly linked to the Federal Government Stocks. Its introduction was expected to serve the desire of the financial institutions to invest a portion of their surplus in an asset linked to the Federal Government Stock. BUF is issued in multiples of 10,000 naira. The money collected from BUF sales are further invested in government securities of varying maturities by the CBN. Investment in BUF counts as part of a bank's liquid assets. Money invested in BUF is repayable on demand, as long as calls are made in multiples of 10,000 naira.

iii Eligible Development Stock:- This instrument consists of Government development stocks of not more than three years maturity, held by the commercial banks. Eligible development stock held also accounts as part of total liquid assets in calculating statutory liquidity ratios of banks, (CBN Annual Report and Statement of Account, 1975).

The Nigerian money market has grown tremendously since these three new instruments. Table 1.3 shows that the total value of outstanding instruments went up from 926,200 naira in 1975 to 24 million by 1985, and to 33.7 million by 1987. This is an increase of more than 3000 percent between 1975 to 1987.

Table 1.3

Money Market Instruments Outstanding
(in 000's of naira)

Instruments	1975	1980	1985	1987
Treasury Bills	616.0	2,119.0	16,976.0	25,226.0
Treasury Certs.	228.0	3,027.6	6,644.0	6,664.1
Bankers Unit Fund	40.0	28.3	20.3	8.6
Eligible Dev. Stocks	7.3	31.7	26.2	26.3
Cert. of Deposits	2.5	120.9	211.7	1,349.4
Comm. Papers	32.4	48.1	218.2	496.4
Total Outstanding	926.2	5,375.6	24,096.4	33,771.8

Sources: CBN Annual Report and Statement of Accounts; Various Issues

1.5 The Capital Market

A capital market or a stock exchange is defined as an organised market that provides

facilities for dealing in stocks and shares; and through which new capital could be raised by offering securities to the public, (Arowolo, 1971). In Nigeria, an organised capital market first came into existence in 1961, when the Lagos Stock Exchange was opened for business. The Lagos Stock Exchange (later named the Nigerian Stock Exchange) with headquarters in Lagos and branches in two other cities is fairly developed by developing country standards.

Table 1.4

Volume and Value of Transactions in the Nig. Cap. Mkt.
(For Some Selected Years)

Year	Volume of Transactions			Valuc of Transactions (in millions of naira)		
	TOTAL	INDUSTRIAL	GOVERNMENT	TOTAL	INDUSTRIAL	GOVERNMENT
1975	694	501	193	63.73	0.903	62.83
1980	7,138	6,918	220	388.80	7.90	380.90
1985	2,3546	23,232	314	318.50	23.20	295.30
1986	27,718	27,448	270	495.60	20.0	475.60
1987	20,648	20,410	238	380.50	42.30	338.20
1988	21,562	21,466	96	249.60	32.50	217.10
1989	33,447	33,273	174	672.4	62.90	609.50

Sources: CBN Annual Report and Statement of Account; CBN Economic and Financial Review (Various Issues).

The Volume and Value of transactions in the Nigerian Stock Exchange grew very rapidly since its establishment. By the end of 1961 (six months after it was opened for business), 334 transactions valued at 760,100 Nigerian pounds had gone through the market. Of the total number of transactions in 1961, 91 were related to government securities and 242 for industrial securities. The total volume of transactions in 1965 was 1,018, with a value of 7.9 million Nigerian pounds. Since 1975, there has been a remarkable increase in the volume and value of transactions carried out in the Nigerian capital market, (see Table 1.4). The dramatic increase in transactions in the mid-1970's was due to the Nigerian indigenisation promotion decree, which required that a controlling interest in all companies should be held by Nigerians. This decree has been amended in 1989 to allow for up to 100 percent acquisition of any Nigerian company, excluding Petroleum related companies, Banks, Insurance companies and other financial

institutions, by foreigners. The decline in the volume of transactions in the later part of the 1980s was due to the general decline in economic activities in the country, brought about by the substantial decline in the petroleum sector. Although there are more industrial securities bought and sold than government securities in any given year, the value of the government securities traded is always more than double that of industrial ones.

An interesting innovation in the Nigerian capital market was the introduction of the "Second Tier Securities Market" (SSM). The SSM was established in 1985 with the aim of assisting small and medium size indigenous companies to have access to the resources of the Capital Market. It is also expected to increase the number and the varieties of securities available for trading in the Nigerian Stock Exchange. The SSM is a capital market within the Nigerian Stock exchange. The requirements for enlisting in the SSM are less stringent than in the main stock exchange. Some of the requirements are as follows:

i Three years trading records, as opposed to five years, are required to enlist in the SSM.

ii Companies are required to submit only audited half-year and annual statements in the SSM, while in the regular market quarterly statements are required to be submitted as well.

iii Companies are required to make at least 10 percent or 50,000 naira worth of their total equity capital available for public subscription. In the regular market, the requirement is either 25 percent of the company's share, or 125,000 naira worth of equity.

iv Companies are required to have no less than 100 shareholders to enlist in the SSM, which is about one fifth of what is required for the regular market.

v Companies are to make a flat annual subscription of 2,000 naira to the stock exchange, instead of graduated annual quotation fees based on the companies' share

capital.

vi Companies who enlist in the SSM are allowed to raise a maximum sum of 5.0 million naira, while there is no limit to the amount raised in the first-tier market.

vii Companies would have to be registered as a limited liability company under the companies Act of 1968 before they can enlist in the SSM.

As of Dec. 1985, only one company was registered in the SSM. By the end of 1987 6 companies have registered in the SSM.

The only other organised capital market in the rest of the ECOWAS sub-region is in the Cote d'Ivoire. Although trading is actively taking place in both new and second securities, the market is still at a rudimentary stage of development, compared to the one in Nigeria.

1.6 The Foreign Exchange Market and Exchange Control

The origin of exchange control in Nigeria was the exchange control act of 1962. The Act made it illegal for Nigerian residents to undertake any foreign exchange transaction without the approval of the exchange control authorities. At the same time, all foreign exchange receipts from exports or any other sources must be surrendered to the Central Bank.

The exchange control measures provided by the 1962 Act, only started being applied effectively in 1967. Since then there has been alternating periods of tight and relaxed controls.

Prior to 1967, although imports of some commodities were prohibited for health or security reasons, most imports were carried out under an open general licence. The foreign exchange for that purpose was guaranteed automatically. Exports of most locally produced goods were made freely under open general licence, except for exports to some Southern African countries. As Nigeria was a member of the sterling area, export proceeds from other sterling area countries were free of exchange control and were

allowed to be kept; however, proceeds from non-sterling area countries were to be converted to local currency within three months of the day of shipment. All payments for invisibles to the sterling area countries were made freely without any controls, but payments to non-sterling area countries required approval from the authorities. Residents of Nigeria travelling to other sterling area countries were allowed to take out an unlimited amount of foreign exchange, but those travelling to non-sterling areas were allowed to take out up to the equivalent of 250 Nigerian pounds in foreign exchange. The exchange control required that receipts from invisibles in currencies other than that of the sterling area countries must be sold to authorised dealers and to be surrendered to the Central Bank.

Movement of capital to and from sterling area countries were free of controls and restrictions. Investments from non-sterling area countries required simple screening to eliminate speculative ventures. Once an investment has been approved, repatriation of the original capital and remittances of profits were allowed freely after local expenses and taxes had been met.

The period between 1967 to 1971, characterised by the Nigerian Civil War, witnessed the coming into effect of new control measures, and a strengthening of existing ones. More goods were placed under the category of goods whose importation was prohibited, while all goods whose importation was not completely prohibited were placed under specific import licences. A national reconstruction surcharge, and import surcharge of 7.5 percent and 10 percent of the c.i.f values of all goods imported were introduced. The countries of the sterling area are now subject to the same set of exchange controls.

With regard to import payments, a foreign exchange budget, where allocation of foreign exchange was made on priority basis, was also introduced for the first time. The CBN now sells foreign exchange in respect of imports, to the authorised banks, who in turn supply the importers, but only against letters of request supported by approved

exchange control forms and certified bills of entry and invoices. Further, a system of mandatory deferred payments for imports now operates. Under this system, payments can only be made, at the earliest, 90 days after arrival of the goods imported into Nigeria.

All other kinds of payments were drastically reduced or were placed under a strict authorisation. The basic travelling allowance for the purpose of travelling to countries outside Africa was first reduced to 100 Nigerian pounds and later to 75. Allowances for the purpose of travelling to African countries were completely suspended. The amount foreign nationals working in Nigeria could remit was first reduced to 50 percent and later to 25 percent of their gross taxable earnings.

Individual export licences were required for the export of the main agricultural commodities (cocoa, cotton, palm products, groundnuts), that were under the respective marketing boards. Exports of petroleum products were subject to special arrangements. Most other remaining products were exported under an open general licence. All exporters were required to submit an exchange control declaration at the time of shipment, and all export proceeds were required to be repatriated and surrendered to the CBN within 3 months of shipment. The same conditions applied to proceeds from invisibles.

All capital related transactions required approval from the Ministry of Finance. This includes residents of Nigeria borrowing abroad, buying and selling of foreign securities, and the repatriation of foreign capital. Non-residents intending to invest in Nigeria were advised to apply for an "approved status", the granting of which meant that sympathetic considerations were given to future requests to repatriate the invested capital.

Between 1971 and 1975 Nigeria experienced a tremendous improvement in its international accounting positions brought about by expanded oil exports and revenues. Further, the civil war came to an end. As a result of these favourable events, exchange controls were generally relaxed. Most controls over imports and import payments were

relaxed. The mandatory deferred payments and the national reconstruction surcharge were abolished. Approval for most payments were easily granted by the authorised dealers. Allowances for travelling outside Africa were increased to 200 naira[2] and within Africa restored to 50 naira per-year per-person. The amount remittable by foreign nationals working in Nigeria was increased to 50 percent of their gross taxable earnings. However, controls with respect to exports and export proceeds, and those relating to capital movement remained unchanged.

1976 to 1979 was another period of tight controls. During these years more laws governing importations were introduced. Most of the new laws were, however, meant to correct certain mal-practices like over-loading of invoices for the purpose of transferring funds abroad, under-invoicing of imports in order to pay less duties, and general falsification of documents, etc.

In 1980 the Nigerian current account surplus went up by more than 50 percent, from the 1979 value of 1,009.5 million naira to 1,593 million; due mostly to the increase in the price of crude oil. As a result, 1980 and parts of 1981 saw another relaxation of controls. By the end of 1981 the situation started to deteriorate. The current account had gone from the 1980 surplus to a deficit of 3,419.4 million naira. The Merchandise account was in deficit for the first time since 1978. The deficit was mainly due to the decline in the volume and value of oil exports, owing to the oil market glut. Oil shipments from Nigeria fell from 701.3 million barrels in 1980 to 458.2 million barrels in 1981. At the same time, the average selling price of Nigerian crude oil fell from 39.76 to 35.78 US. dollars per barrel between 1980 to 1981. The total value of Nigeria's oil exports fell by 24 percent during this period. The decline in the volume and value of oil exports and therefore Nigeria's adverse economic condition continued throughout the 1980s.

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[2] *Nigeria changed its currency from pounds to naira in 1973. The value of the new currency was fixed at one half of the old currency.*

The period between 1981 to 1986 (the introduction of the Second Tier Foreign Exchange Market)[3] witnessed the coming into effect of the most stringent set of controls Nigeria has ever experienced.

Imports to Nigeria within this period were classified into prohibited, and those subject to specific import licences. Open general import licences were abolished in 1984. Prohibited imports were further divided into those that were absolutely prohibited and those that may be imported only as personal effects. The former category contained about 20 items, while the later one was made up of about 68 items. Included in the latter category were goods like vegetables and fresh fruits, textile fabrics, beer, fresh milk, tooth paste, passenger cars with a c.i.f value in excess of 15,000 naira, or an engine capacity exceeding 2,500 cc. Issuance of import licences for the category of goods whose importations were not prohibited was made subject to a foreign exchange budget, and according to domestic demand and supply conditions of the commodity. In addition, a priority list which emphasises raw materials, spare parts, machinery, and certain major food items was followed. Applications for import licences by manufacturing firms were evaluated against the following criteria: 1) the extent to which the manufacturing firm concerned used local raw materials 2) foreign exchange earnings generated by the firm's output 2) the linkage effect of the final product of the firm (how easily a firm's output can be used as an input to another firm) 4) the amount of capital invested in the firm, together with its turnover. and 5) The geographical location of the firm.

An application for a foreign exchange form (known as an "M" form) was required to be completed for all imports into Nigeria, irrespective of value. An approved M-form acts as a foreign exchange release order. The processing, registration, and the initial approval of M-forms were carried out by the authorised dealers, on behalf of the CBN. However, the final approval continued to depend upon confirmation by the CBN.

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[3] *See next section of this chapter for a discussion on the Second Tier Foreign Exchange Market (SFEM)*

Completed M-forms were submitted in septuplecate; accompanied by the import licence for the goods to be imported, a tax clearance certificate (showing settlement of all tax liabilities) covering the previous three years, a pro forma invoice for the imports, showing the price split into f.o.b and freight, with all other charges, such as commission and interest charges shown separately. It is only after an M-form has been processed and registered that an importer can confirm his order to the seller. In the absence of a registered M-form, a letter of credit may not be opened, nor may any form of payments for imports be effected.

Payments for any import were only made after the submission to the CBN of a full set of documents, evidencing the receipt of the goods in the country. If the CBN finds all the documents issued to be satisfactory, the office of exchange control issued a foreign exchange release order (an accepted M-form) to the foreign exchange operation department of the CBN, who released to the authorised dealers the required foreign exchange to effect payment for the imports.

All imports valued at more than 1,000 naira were made subject to a pre-shipment inspection. The inspection was to ensure that all imports into Nigeria were of the correct quality and quantity according to the contracts, and that only the normal price of that commodity in the country of supply was paid. Only after a "clean report of findings" on goods to be imported has been issued, was the foreign exchange settlement for imports made.

An "A-form", subject to a similar processing procedure as the M-form, was used to apply for foreign exchange to effect any payments for invisibles. However, approval for most kind of invisibles were granted by the authorised dealers. All insurance for which facilities existed, were required to be taken out with a company in Nigeria. The basic travelling allowance was reduced to the equivalent of 100 naira per adult person per-year. The business travel allowance, as well as the allowance for travel within Africa, were suspended. The remittances by foreign nationals working in the country were reduced to

25 percent of their net earnings.

Nigeria's export policy in this period was geared towards assisting local producers, and towards attaining self sufficiency in food production. As a result, all exports were either prohibited or subject to licensing requirements. Exportation of 11 items, which included beans maize, rice, milk, groundnuts oil, and all imported food products was completely prohibited. Exportation of about 36 products required export licences. Export of cotton, cocoa, groundnuts and palm kernels were carried out only by the respective Marketing Boards.

The Boards had the sole responsibility of purchasing these products from the farmers. The Marketing Boards were set up with the aim of stabilising the price farmers received for their products. In a season of bumper harvest, the Boards kept the surplus and sold what was necessary to maintain a certain price level. If the harvest for any given year was small, and the price was going to go up as a result, the Boards sold their stored surplus to keep the price down to the required level. Likewise, when the international price of these commodities went up, the Boards still paid the farmers the same price and kept the excess to supplement periods when international prices went below what the farmers were supposed to receive. However, as time went on, the Boards became more of a hindrance than a help to the farmers. Low prices were passed on to the farmers, but when prices went up the excess was kept.

Exports of petroleum products were handled by the Nigerian National Petroleum Corporation. Export proceeds were required to be surrendered to the CBN through an authorised dealer within three months of shipment. Proceeds from invisibles in foreign currencies were also required to be sold to the authorised dealers for surrender to the CBN. It was also necessary for all exporters to submit an exchange control declaration at the time of shipment.

Restrictions regarding the movement of capital remained virtually the same. Permission of the Ministry of Finance was required for any individual, firm, company, or

branch, resident in Nigeria to borrow from abroad. Official agencies, and state controlled corporations also required an approval of the Ministry of Finance to borrow from abroad.

Residents of Nigeria were not allowed to deal in foreign currency securities, buy from or sell to non-residents of Nigeria any security payable in naira without the permission of the Ministry of Finance. Non-residents intending to make a direct investment in Nigeria were to apply for an "approved status", otherwise, future requests to repatriate the invested capital and related profits would not receive a sympathetic hearing from the authorities. Generally, repatriation of foreign capital requires approval from the Ministry.

Since October, 1986, with the coming into effect of the Second Tier Foreign Exchange Market (SFEM), most controls (especially exchange controls) have been removed. Some of the changes that took place since 1986 were as follows: To start with, import licencing and the 30 percent import surcharge[4] were abolished. By 1988, the list of prohibited imports had been cut from the 1985 level of 72 items to 16 items. Among the prohibited list in 1988 were cigarettes, poultry (except day-old chicks), vegetables, fresh fruits, potatoes, eggs, textile fabrics, beer, fresh milk, rice and rice products, maize and maize products, wheat and wheat products, mineral water, and all sparkling wine.

Payments for imports since 1986 are made by an overseas representative of the authorised dealers, upon presentation of confirmed letters of credit by an importer. Such payments are made with the understanding that the goods paid for will arrive in Nigeria and that all shipping documents relating to the imported goods are lodged by importers with the authorised foreign exchange dealer, as an agent of the Nigerian Government, within 21 days of negotiation of these documents. Further, a bill of entry must be submitted to the authorised exchange dealer within 90 days of negotiation and payment by an overseas representative bank. All imports valued at US$5,000 (c & f), or more,

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[4] *This surcharge was introduced on January 1st, 1986, as a part of the national budget that year, to be imposed on all imports, in addition to existing duties.*

except those specifically exempted by the government, are subject to pre-shipment inspection for reasons stated earlier. Foreign exchange for the settlement of the imports is effected only if the result of the inspection is satisfactory.

With regard to payments of invisibles, although basic allowances are provided for most payments, applications for amounts in excess are automatically approved, if it can be proven that the intention of the applicant is not to transfer capital abroad. The basic allowance for tourist travel is now fixed at US$ 500 per adult person per year. The allowance for business travel was fixed at US$2,500 per trip per enterprise, subject to a maximum of two trips in any given year. The basic travelling allowance for international conferences and seminars is US$1,500 per trip per person, with a maximum of two trips in a year. The amount an expatriate working in Nigeria can remit abroad was also increased to 75 percent of the net salary after tax.

The changes made with regard to exports are as follows: all export licensing requirements, export bans and export duties were eliminated. To encourage the production and export of non-oil agricultural products, and thus reduce the country's dependence on oil for its foreign exchange, all marketing boards were eliminated. Henceforth, farmers exported their products themselves. With effect from September, 1986, all surrender requirements were eliminated. Exporters of non-oil products were allowed to retain the proceeds of their exports, subject to repatriating it and keeping it in a Domiciliary Account, or to selling it freely in the foreign exchange market (FEM). A Domiciliary Account is a foreign currency account residents of Nigeria can operate inside the country since Oct. 1985. The operation of a Domiciliary Account is free of exchange control formalities and it is tax exempt. Interest is paid in foreign currency, at a rate comparable to the ruling interest rates for the currency of deposit. Account owners could use their deposit for any purpose, including import transactions, but were prohibited from selling funds in their accounts for use outside the banking system. Controls on movement of capital into and out of the country remained the same.

The very strict exchange regime described above is characteristic of the member countries of ECOWAS, with the exception of the members of WAMU. The WAMU countries have a very liberal exchange regime with respect to dealings with all countries that have an operation account with the French Treasury. However dealings with all other countries including the non-WAMU countries of ECOWAS are strictly controlled. As pointed out earlier, the strict exchange regime that exists in the sub-region, especially with regard to member countries, may have been partly responsible for the small level of trade among the member countries of ECOWAS.

1.6.1 The Second-Tier Foreign Exchange Market (SFEM)

SFEM is an arrangement designed to introduce some elements of market forces in the determination of the exchange rate of the Nigerian currency. It was introduced in September 1986 as a part of the general structural adjustment programme adopted in the country.

The exchange rate for the naira in the SFEM is determined through auctions carried out either weekly or fortnightly. The CBN (the supplier of the foreign currency) offers a certain amount of foreign currency in every auctioning session to be bid for by the authorised foreign exchange dealers. The dealers include commercial banks and merchant banks, that have operated in the country for at least three years. For the first few weeks, auctioning took place weekly. The going exchange rate for naira was determined using the "Marginal Pricing" system. Under this system, the foreign exchange dealers each bid for a certain amount of foreign exchange at a certain price. Each bidder's price and the amount it bid for were displayed, with the highest bidder, price wise, at the top of the list and the lowest bidder at the bottom. The dealer that bids the highest would be allocated the amount he bid for, then the next highest bidder, until the amount of foreign exchange supplied to the market is exhausted. The bid price by the last successful bidder which clears the market is the Marginal Price, and that will be the exchange rate of naira until the next bidding session. All successful dealers paid the

marginal rate for the amount they succeed in getting. The dealers then sell the foreign exchange to their customers at the margin price, plus a percentage determined by the CBN. On the first auction session, the value of naira fell by 66 percent to 4.6124 naira to one US dollar.

The marginal pricing system encouraged dealers to bid unreasonably high prices. This is the case because those whose bid prices are the highest are assured of the amount they bid for, yet they pay the marginal price, which is always lower or equal to any successful bidder's bid price. As a result the naira continuously depreciated. In April 1987, the "Dutch Auction System" was adopted. The new system required that bidders pay the price they bid at, while the market clearing price is the one that determines the going exchange rate. This system is supposed to discourage bidding very high prices, since the price dealers bid is what they paid, while selling can only take place at the market clearing rate plus a fixed margin.

All transactions, except government debt settlements, contributions to international organisations, and transfers to Nigerian missions abroad were channeled through the SFEM. The exchange rate in the First Tier Market was fixed by the government. However, as planned the two markets were merged in July 1987, and was renamed the Foreign Exchange Market (FEM). Since then, all foreign exchange transactions are carried out at the market determined rate. Apart from Nigeria, another member country of ECOWAS, Ghana, has also adopted this procedure of determining a realistic exchange rate. Attaining a realistic exchange rate through the SFEM, although not undertaken with that purpose in mind, moves Nigeria towards fulfilling the initial requirement for the ECOWAS monetary cooperation programme.

1.7 Summary and Conclusion

The principal institution in the Nigerian financial system is the Central Bank. Established in 1959, the Central Bank of Nigeria performs the traditional functions of organising and executing the monetary policy of the country. Although it is within its

power to use all the traditional tools of monetary policy, the Central Bank has concentrated on just a few. It has never used open market operations and its use of the liquidity ratio to contract credit has not been effective. The liquidity ratio has been changed only twice since its inception in the early 1960s, even then the actual ratio has always remained above the prescribed one. Two of the tools utilised quite often with varying degree of success are the discount rate and direct credit controls. The Central Bank of Nigeria has changed the discount rate, as well as other interest rates many times since 1962.

The Central Bank of Nigeria has also been an agent of government deficit financing. It raises funds for the Government not only by printing and selling securities to the public, but also purchases a substantial part of any issue. The loss of this particular function, in the event of the ECOWAS monetary unification, is likely to cause the most concern to the Federal Government of Nigeria.

Nigeria also has a number of commercial banks, both foreign and domestic owned ones. As at the end of 1987, there were 33 commercial banks with 1,483 branches in Nigeria. Besides being the main agent through which monetary policy is effected, the commercial banks in Nigeria play a vital part in financing the government deficit. A sizeable percentage of government securities are purchased by the commercial banks. At present, the Nigerian commercial banks do not have branches in the other ECOWAS countries. This is partly because of the fact that regulations about establishing and operating banks differ a great deal between the member countries of ECOWAS. However, the ECOWAS monetary unification is expected to solve this problem and thus enhance the possibility for the Nigerian commercial banks to expand to other member countries of ECOWAS. In addition to the commercial banks, Nigeria has a number of merchant banks and development banks.

One of the two stock exchanges that exist in the sub-region is in Nigeria. The other is in Cote d'Ivoire. The Nigerian stock exchange has been operating since 1961 and a

sizeable amount of both private and government stock and other securities have passed through the Nigerian stock exchange. Since the "oil boom" of the early 70s, trading in the Nigerian stock exchange has expanded considerably, both in volume and value. The ECOWAS monetary integration is likely to expand the activities of the Nigerian stock exchange. In fact, it is possible for this stock exchange to be an important centre for financial activities of the sub-region.

Chapter 2

The Stability/Predictability of the Money Multiplier and the Controllability of the Monetary Base in Nigeria

2.1 Introduction

The theory of money supply encountered in most standard textbooks is that of the money multiplier model of money stock determination. According to this theory the money stock at any given point in time is a multiple of the monetary base, where the multiplying factor is known as the money multiplier.

The money multiplier is often expressed as an identity derived from a combination of the currency to deposit and the reserve to deposit ratios.[1] These ratios are behavioural variables determined by the non-bank publics' preference for currency over deposit and the banks' preparedness to give out loans, thus reducing their reserves and increasing their deposits. The monetary base, on the other hand, is commonly defined to be the sum of currency with the non-bank public and the reserves of the deposit money banks.[2]

Altering the money stock for monetary policy purposes, within the framework of the money multiplier model of money stock determination and given a stable money multiplier, requires a change in the monetary base. If the money multiplier is variable (presumably as a result of variations in the two ratios), the change in the monetary base would have to be such that the variations in the money multiplier are also offset.

The main aim of this chapter is to investigate the ease with which the Nigerian monetary authorities could change the money stock for monetary policy purposes, and so

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[1] *Cagan (1965) and Friedman & Schwartz (1963) express the currency ratio in terms of currency to money rather than currency to deposit.*

[2] *Comprising commercial banks and other banks that have large demand deposits.*

effectively test their ability to carry out monetary policy within the framework of the money multiplier model. To achieve this, the stability of the Nigerian money multiplier since 1960, and the accuracy with which its values can be predicted is investigated. Also the ease with which the monetary authorities can alter the monetary base is examined.

The remainder of this chapter is organised as follows: Section (2.2) discusses the theoretical background to the money multiplier approach to money stock determination. Section (2.3) looks at the issue of the stability of the money multiplier and its determinants. In section (2.4) models of the money multiplier and its determinants, with a view to estimating it using Nigerian data, are presented and discussed. The econometrics modelling procedure employed for the purpose of estimating the models of section (2.4) is presented in section (2.5). The findings of estimating the money multiplier and the determinants are presented and discussed in section (2.6). Section (2.7) takes up the issue of controllability of the monetary base in Nigeria. Finally the summary and conclusion to the chapter are presented in section (2.8).

2.2 Theoretical Background

The issue of the ability of a country's monetary authority to control the money stock, in the context of the money multiplier model, is centered around the specification and the predictability of the relationship between the money stock and the monetary base. According to this model of money stock determination, the money stock at a given point in time is a multiple of the monetary base, the multiplying factor being the money multiplier. In other words, a given change in the monetary base would have multiple effects on the money stock.

The money multiplier model is an extension of the bank deposit multiplier approach to deposit creation, (Pierce and Tysome, 1985). According to this approach to deposit creation, the total deposits of an economy is equal to a multiple of the banks' free/excess reserves. For example, if a commercial bank receives a certain amount of cash from a customer for deposit, its total reserves will go up by that amount (ΔR). Since cash does

not earn any interest, profit maximisation principles require that the new reserves are put into money making ventures. A commercial bank can either lend to customers, or purchase some interest earning short-term assets, such as government securities, etc. However, a certain percentage of the increase in reserves would have to be kept either in cash or in some near cash assets to meet any eventual desire to withdraw by the depositors. To maintain public confidence in the banking industry and to prevent panics and the collapse of the financial system of a country, the minimum percentage of the total deposits to be held for that purpose, is often imposed by law. This fraction is commonly known as the required reserve ratio.

The one shot increase in the commercial bank's cash deposit is going to lead to a multiple expansion of deposits. From the initial cash deposit, the commercial bank can loan out the amount ($\Delta R\,(1-r)$) which is the excess reserves, where (r) is the required reserve ratio. This is the first round of the deposits expansion process. If the amount lent out were to be deposited with the bank, or for that matter, another bank, a second round of the deposits creation process will set in. If the required reserve ratio remains at (r), an amount ($\Delta R\,(1-r)^2$) of excess reserve will now be made available to be lent out, and so on. The total amount of deposit created by the one shot increase in cash deposit can be represented by a geometric progression expressed by equation (2.1) below.

$$\Delta D = \Delta R + \Delta R\,(1-r) + \Delta R\,(1-r)^2 + \ldots\ldots + \Delta R\,(1-r)^n \tag{2.1}$$

$$(1-r)\Delta D = \Delta R\,(1-r) + \Delta R\,(1-r)^2 + \ldots\ldots + \Delta R\,(1-r)^{n+1} \tag{2.2}$$

$$\Delta D = \frac{\Delta R - \Delta R\,(1-r)^{n+1}}{r} \tag{2.3}$$

$$\Delta D = \frac{1}{r}(\Delta R) \tag{2.4}$$

$$D = \frac{1}{r}(R) \tag{2.5}$$

Multiplying both sides of equation (2.1) by (1-r) gives equation (2.2). Equation (2.3) is arrived at after subtracting (2.2) from (2.1) and solving for ΔD. As "n" approaches infinity, equation (2.3) can be written as (2.4). According to this equation, the total amount of deposit created at the end of the day (ΔD), as a result of the one shot cash

deposit (ΔR), is a multiple (1/r) of the initial cash deposit. Since the required reserve ratio (r) is less than one, (ΔD) is necessarily greater than (ΔR). In general, the amount of deposits in the economy at any given point in time, is given by equation (2.5). The total deposits in the economy are a multiple (1/r) of the total reserves. The multiplication factor (1/r) is known as the deposit multiplier.

2.2.1 The Money Stock Equation

The derivation of the money stock equation in the context of the money multiplier model, in its simplest form, is presented below.[3]

$$M \equiv D + C_p \tag{2.6}$$

$$H \equiv R + C_p; \quad R = rD, \; C_p = cD \tag{2.7}$$

$$M \equiv D(1 + c) \tag{2.8}$$

$$H \equiv D(r + c) \tag{2.9}$$

$$M \equiv \left[\frac{1 + c}{r + c}\right] \cdot H \equiv MULT \cdot H \tag{2.10}$$

Equation (2.6) states that the money stock is identically equal to the sum of deposits in the banking system and the currency held by the non-bank public. This can either be the narrow definition or the broad definition of money. If (M) is narrow money, (D) is demand deposits. In Nigeria, this amounts to the demand deposits with the banking system net of federal government's demand deposits. The narrow definition of money stems from its function as a medium of exchange for goods and services. Both demand deposits and currency held by the non bank public qualify as money because they are held for the purpose of making payments for goods and services only. In other words, assuming that demand deposits do not pay interest, the only reason why an economic agent would hold them is to carry out transactions. However, there are other functions of money besides being a medium of exchange for goods and services. Specifically, money also performs the important function of being a store of value. Economic agents

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[3] *This method of deriving the money stock equation is mainly due to Courchene, 1969.*

therefore, in addition to the need to carry out transactions, would want to hold money as a means of storing their wealth. Accordingly, money can be broadly defined to include other assets like savings and time deposits that can be used for storing wealth. If (M) is to represent a broad definition of money, (D) would be demand deposits as defined above plus the sum of savings and time time deposits with the commercial banks (quasi money).

Equation (2.7) defines the high powered money or the monetary base (H) as identically equal to the sum of the commercial banks' reserves (R) and the currency with the non-bank public (C_p). The reserves of the commercial banks are normally defined to be the sum of vault cash and the deposits with the central bank. However in some countries, certain highly liquid assets besides vault cash and deposits with the central bank are reserve eligible. For example, in Nigeria, the treasury bills held by the deposit money banks count as part of their required reserves. According to the definition of the monetary base given in Courchene (1969) (all monetary assets capable of being used as bank reserves), the treasury bills held by the deposit money banks in Nigeria should be counted as part of the banks' reserves. Ajayi (1971) and Ojo (1976) agreed with the idea of treating treasury bills held by the Nigerian commercial banks as a component of the monetary base.

This definition of the monetary base (banks' reserves and the currency held by the non-bank public) constitutes the uses of the monetary base. Alternatively, the monetary base can be defined in terms of its sources; which amounts to the sum of all items on the assets side of the central bank's balance sheet, minus the items on the liability side except currency and the deposits of the deposit money banks.

From equation (2.5), the bank reserves (R) can be expressed as the ratio of reserves to deposits (r) multiplied by total deposits. Similarly, the amount of cash with the non-bank public can be expressed as the currency to deposits ratio (c) multiplied by the total deposits. Utilising these expressions, equations (2.6) and (2.7) can be written as (2.8)

and (2.9). Dividing equation (2.8) by (2.9) and solving for the money stock (M) gives equation (2.10). Equation (2.10) is the money multiplier specification of the money stock equation.

The money stock is identically equal to the monetary base multiplied by the money multiplier. The money multiplier is a function of the publics' desired currency to deposit ratio and the commercial banks' reserve to deposit ratio. According to the definition of the money multiplier given in equation (2.10), an increase in either of these ratios has the effect of reducing the value of the money multiplier. For a given increase in the high powered money, the resultant expansion in the money stock will be smaller, the higher the values of the two ratios. A higher currency to deposit ratio implies that the public is increasingly holding more cash than bank deposits. Looking at the deposit creation activity of the banks described earlier, for a given required reserve ratio, the smaller the amount of cash deposited, the smaller would be the total amount of deposits created at the end of the exercise. Similarly, a high reserve to deposit ratio implies that the commercial banks hold back more resources from entering the deposit creation process, and as such, less deposits are created.

The money stock equation (2.10) and the resultant money multiplier are not unique. Different specifications abound in the literature, (see for example Ojo 1976, Beenstock 1989, Cagan 1965, Friedman et al 1963, to mention a few). The differences are basically that of the specification of the determinants of the money multiplier. For example, in Cagan (1965), the denominator of the currency ratio is the money stock and not deposits. while in many other cases, instead of lumping all deposits together for the purpose of currency to deposit and reserve to deposit ratios, the deposits are separated into demand, savings, and time deposits. However for the purpose at hand, the specification given in (2.10) is quite sufficient, since in Nigeria, the required percentage to be held as a reserve by the banks is the same for all types of deposits.

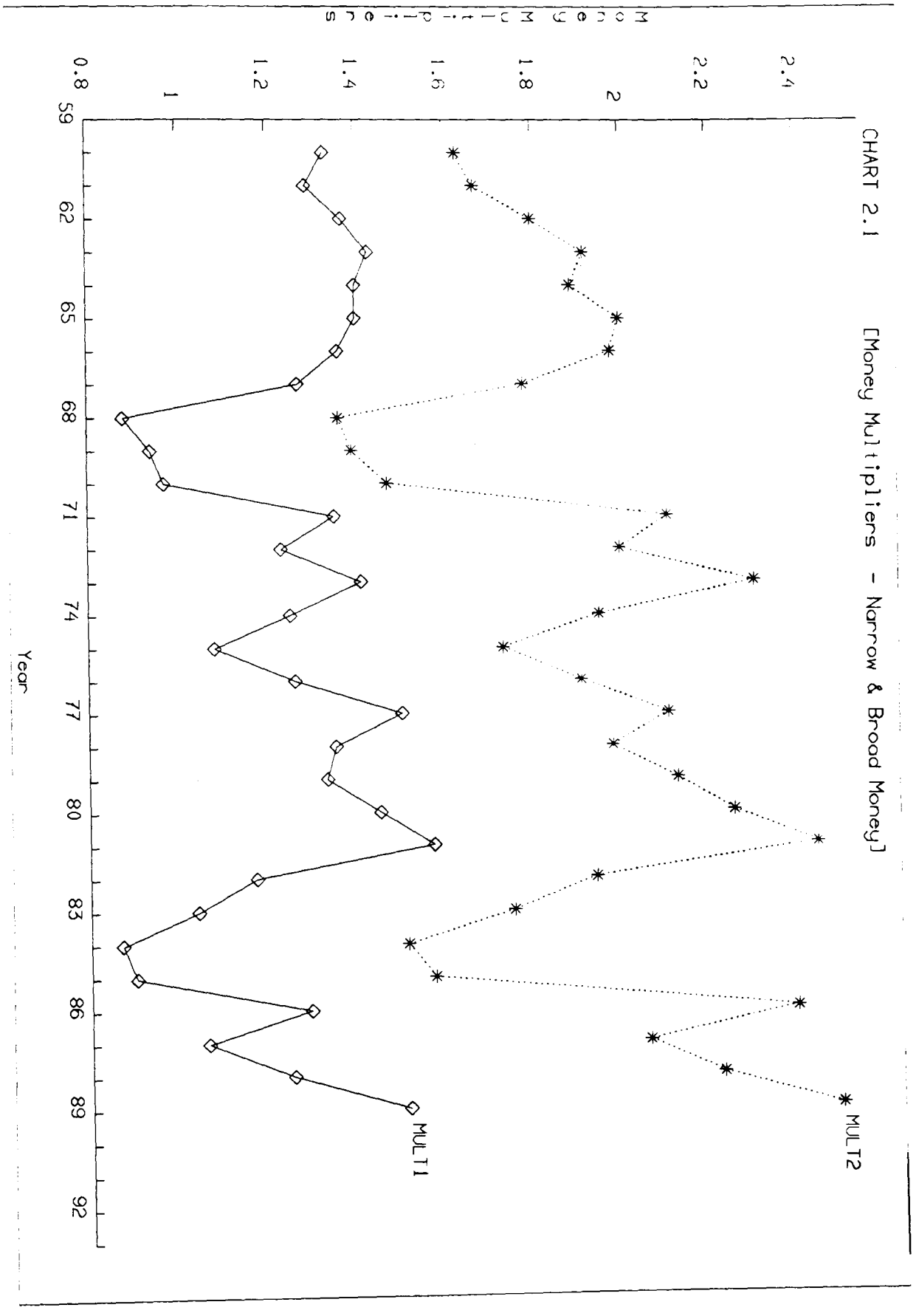
A change in the money stock, according to this model, arises as a result of a change

in the determinants of the money multiplier (currency to deposit and the reserve to deposit ratio) or a change in the monetary base. Variations in the ratios and therefore, the multiplier are regarded as endogenous. They are determined by factors which alter the public's behaviour towards currency vis-a-vis deposits and the banks' behaviour towards holding more reserves. The monetary base, on the other hand, is assumed to be exogenously determined by the central bank. Since it is its liability, the central bank can change it at will.

Monetary policy (change in the money stock), within the money multiplier framework, amounts to changing the monetary base in the desired direction for a given, stable money multiplier. However, if the money multiplier moves around constantly, presumably as a result of changes in the two determining ratios, the monetary authorities would have to be able to forecast the values of these ratios and then offset the variations suitably using the monetary base. If, for example, the desire was to increase the money stock by a certain amount next year, the monetary authorities can forecast the money multiplier, and buy the appropriate amount of short-term assets from the commercial banks and the public. This will increase the banks' free reserves, enabling them to expand deposits through the deposit expansion process described above. However, this analysis overlooks some vital issues. Can the monetary authorities persuade the commercial banks and the public to sell their assets, or in the case where a reduction in the money stock is required, to persuade them to buy more assets? This introduces the question of endogeneity of the monetary base and the money stock. A detailed discussion of this issue, together with a critique of the money multiplier approach to money stock determination will be taken up in the next chapter.

Generally, the issue of the ability of a country's monetary authorities to control the domestic money stock, in the context of the money multiplier model, depends on the answers to the following questions:

CHART 2.1 [Money Multipliers - Narrow & Broad Money]



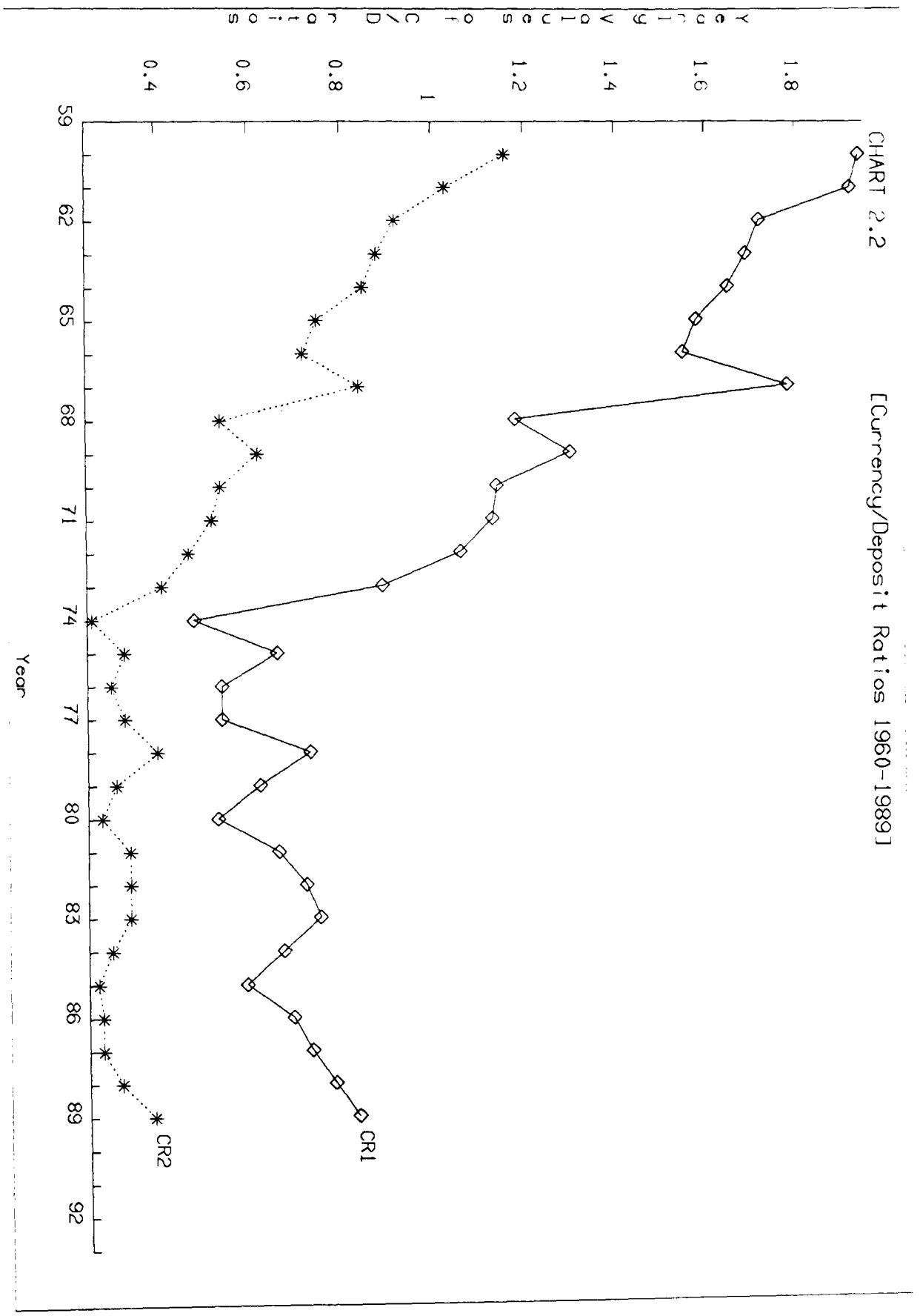


CHART 2.2
[Currency/Deposit Ratios 1960-1989]
Velocity of C/D Ratios
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
59
62
65
68
71
74
77
80
83
86
89
92
Year
CR1
CR2

CHART 2.3 [Reserve to Deposit Ratios]

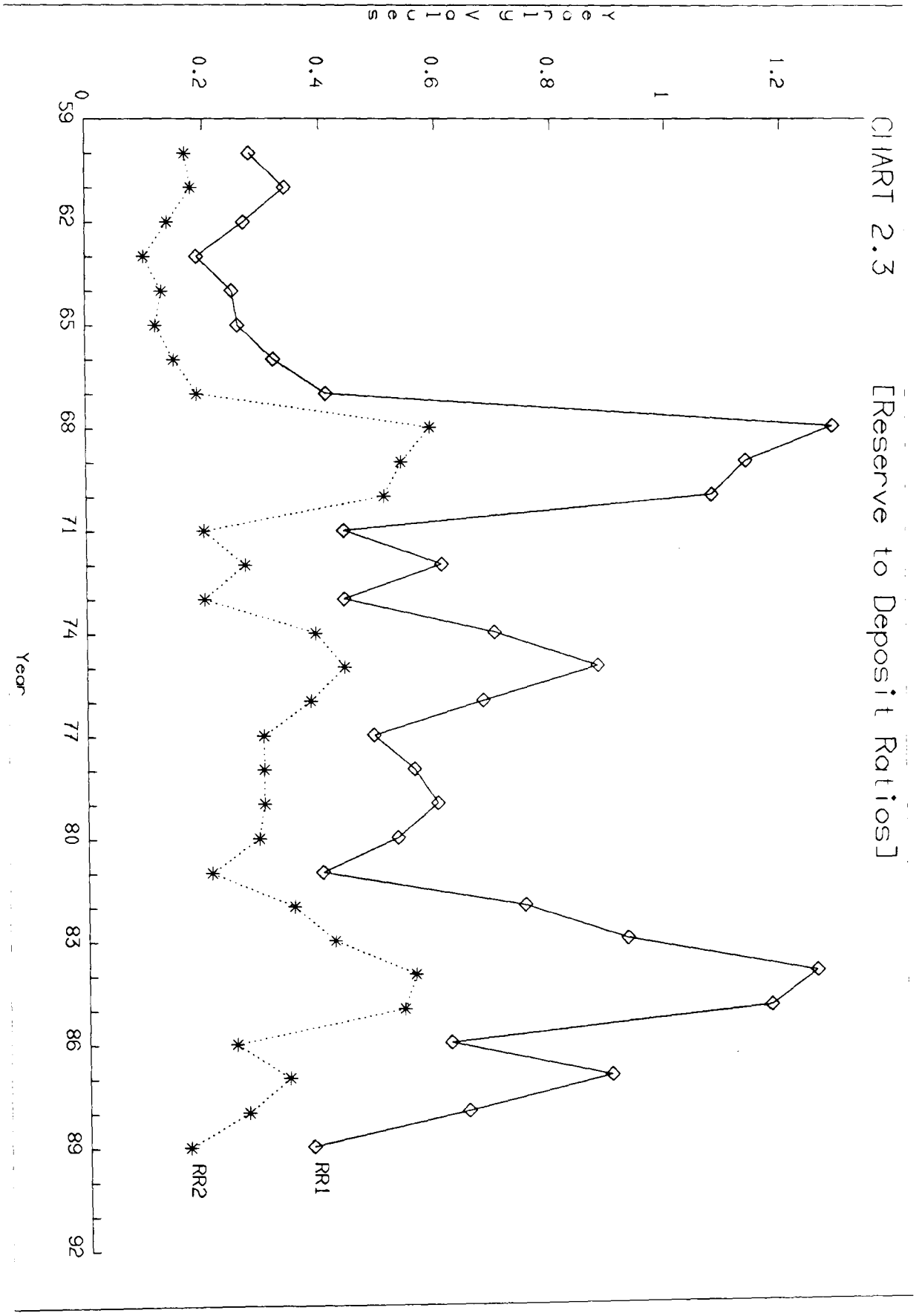


Table 2.1

%Δ in the Money Multipliers and the Determinants
(Narrow and Broad Definitions)

YEAR	% Δ MULT1	% Δ MULT2	% Δ CR1	% Δ CR2	% Δ RR1	% Δ RR2
1960-61	-2.41	2.77	-1.20	-11.04	21.65	9.54
1961-62	5.79	7.66	-10.19	-10.42	-20.97	-21.18
1962-63	4.27	6.61	-1.77	-5.32	-27.15	-29.78
1963-64	-2.21	-1.51	-2.37	-2.95	27.84	27.07
1964-65	0.42	5.94	-4.08	-11.74	4.59	-3.76
1965-66	-3.00	-1.19	-2.06	-4.51	25.31	22.18
1966-67	-6.73	-10.00	15.13	17.02	26.37	28.45
1967-68	-30.46	-23.60	-33.84	-35.59	214.68	206.37
1968-69	6.73	2.35	10.46	14.59	-11.48	-8.17
1969-70	2.51	5.49	-12.88	-13.34	-5.76	-6.27
1970-71	40.32	43.19	-0.81	-3.60	-58.83	-59.98
1971-72	-8.92	-5.61	-5.63	-9.03	37.41	32.46
1972-73	14.87	16.07	-16.34	-13.48	-27.16	-24.67
1973-74	-11.65	-15.71	-46.03	-35.12	58.19	90.19
1974-75	-13.93	-11.18	36.40	24.19	25.46	14.22
1975-76	17.10	10.43	-17.93	-8.23	-22.69	-13.56
1976-77	18.99	10.62	-0.18	9.91	-28.51	-21.29
1977-78	-10.38	-6.00	36.53	21.65	14.02	1.59
1978-79	-1.26	7.30	-15.47	-22.03	8.00	-0.37
1979-80	8.87	5.97	-14.84	-9.31	-11.84	-6.11
1980-81	8.20	8.49	24.47	19.37	-23.96	-27.07
1981-82	-25.40	-20.75	10.42	-0.24	87.24	69.16
1982-83	-11.04	-9.66	3.75	0.77	24.24	20.68
1983-84	-16.71	-14.06	-11.28	-12.51	34.78	32.90
1984-85	3.65	4.23	-11.52	-9.85	-6.09	-4.32
1985-86	43.47	52.78	17.18	4.41	-47.32	-53.06
1986-87	-17.30	-14.00	5.79	-0.80	3.76	34.80
1987-88	17.20	8.27	6.91	16.48	-27.77	-21.30
1988-89	21.70	11.94	5.45	16.49	-41.63	-35.52

MULT1=M1/Base Money; MULT2=M2/Base Money; CR1= C_p/DD; CR2 = C_p/(DD+TD); RR1= Reserve/(DD); RR2= Reserve/(DD+TD);

Table 2.2

%Δ in the Components of Currency and Reserve Ratios
(1960 to 1989)

YEAR	% ΔC_p	% Δ DD	% Δ TD	% Δ TBLS	% Δ RES	% Δ RES1
1960-61	0.00	1.22	29.09	60.98	15.79	23.14
1961-62	0.63	12.05	12.68	13.47	-18.18	-11.45
1962-63	5.63	7.53	16.25	-64.69	-5.56	-21.67
1963-64	17.16	20.00	21.51	350.84	11.76	53.41
1964-65	1.52	5.83	24.78	20.32	5.26	10.70
1965-66	7.96	10.24	15.60	73.97	15.00	38.13
1966-67	-4.61	-17.14	-19.63	27.34	-17.39	4.71
1967-68	-11.59	33.62	40.46	519.41	21.05	320.48
1968-69	38.25	25.16	16.85	11.06	8.70	10.79
1969-70	35.18	55.15	56.74	40.90	88.00	46.21
1970-71	3.80	4.65	10.39	-63.31	-19.15	-56.91
1971-72	8.45	14.92	22.85	73.65	15.79	57.91
1972-73	13.25	35.36	27.35	-14.21	50.00	-1.41
1973-74	30.73	142.24	67.18	231.68	401.52	283.22
1974-75	80.88	32.60	61.56	4.40	160.42	66.36
1975-76	31.04	59.66	25.89	-9.57	43.50	23.42
1976-77	43.67	43.93	13.95	-31.94	16.25	2.89
1977-78	11.13	-18.61	7.32	61.10	-22.53	-7.19
1978-79	8.99	28.94	52.98	160.07	-17.15	39.27
1979-80	35.52	59.14	39.47	21.30	68.15	40.30
1980-81	21.22	-2.62	6.41	-40.98	-10.05	-25.95
1981-82	9.35	-0.97	20.95	143.80	44.91	85.42
1982-83	14.68	10.54	16.66	100.56	-36.48	37.33
1983-84	0.85	13.66	16.60	72.57	-18.21	53.19
1984-85	0.53	13.62	9.81	10.34	-21.60	6.70
1985-86	5.46	-10.00	10.24	-64.96	82.77	-52.59
1986-87	21.65	14.99	27.85	74.40	46.22	65.30
1987-88	49.45	39.79	21.24	-1.42	6.95	0.97
1988-89	23.95	17.54	-1.49	-52.09	16.39	-31.39

C_p = Currency with the non-bank public; DD = Demand Deposits; TD = Time + Savings Deposits; TBLS = Treasury Bills outstanding with the Commercial and the Merchant Banks; RES = Vault Cash + Balances with the Central Bank; RES1 = RES + TBLS;

1) Are the ratios (currency to deposit and reserve to deposit) stable enough, so that the monetary base can be changed to achieve the desired level of money stock? If the ratios and the multiplier are variable, can the monetary authorities forecast the values of these ratios and use the monetary base to offset any variations that might arise?

2) Do the monetary authorities have enough control over the monetary base, to use it to offset variations in the ratios, as well as to change it to achieve a certain desired level of money stock?

2.3 Stability of the Money Multiplier

One way of investigating the stability of a country's money multiplier, is to observe its behaviour through time. If for example, the annual value changes quite considerably from one year to the next, then the money multiplier is likely to be unstable. Alternatively, the difference between the lowest and the highest value obtained within a given period of time can be examined, with a view to concluding that the money multiplier is unstable if the difference is found to be relatively large. Ajayi (1971) uses this method to conclude that the quarterly money multiplier for Nigeria between 1960 to 1969 is not stable. The main weakness of this procedure is that, it does not make allowances for fluctuations due to either seasonality or random shocks and regime shifts whose effects are felt at that period only.

A cursory observation of the graphs of annual values of broadly and narrowly defined[4] money multipliers, currency ratios, and reserve ratios for Nigeria presented in Charts 2.1 to 2.3 reveals that these variables have experienced some large fluctuations between 1960 to 1989. Between 1967 to 1968, the narrow and broad money multipliers fell by about 30 and 23 percent respectively. Narrow and broad currency to deposit ratios

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[4] *Narrow money multiplier (MULT1) = M1/Base; Broad multiplier (MULT2) = M2/Base; Narrow currency ratio (CR1) = C_p/DD; Broad one (CR2) = C_p/(DD+TD+SD); Narrow reserve ratio (RR1) = Banks' reserve/DD; Broad one (RR2) = Banks' reserve/(DD+TD+SD).*

both fell by about 35 percent, while both broadly and narrowly defined reserve to deposit ratios went up by over 200 percent. After about three years of relative stability, there was another major fluctuation from 1970 to 1971. Both narrow and broad multipliers went up this time, while both currency and reserve ratios fell; the reserve ratio more so than the currency ratio. Other periods of instability in the history of the Nigerian money multipliers are between 1973 to 1974, 1981 to 1982 and 1985 to 1986. See Table 2.1 for the degree and direction of change in the money multipliers and the determinants in these periods. However, as detailed below, each one of the above mentioned periods of major fluctuations is characterised by a regime shift or some kind of shock to the Nigerian economy.

2.3.1 1967 - 1968

This period is characterised by the Nigerian civil war which went on from July, 1967 to January 1970. Two main events occurred in 1968, which made the year stand out as far as the fluctuation of the Nigerian money multiplier is concerned.

First is the issuance in January 1968 of new bank notes of different design to replace the old ones. The main reason behind the change was to safeguard the international value of the Nigerian currency from being undermined by the rebels through illegal trafficking, (CBN Annual Report, 1968 p. 30). The exchange exercise was carried out from the 3rd to 22nd of January in 9 out of the 12 states of the federation. At the end of the exercise, all old notes ceased to be legal tender and thus ceased to be counted as part of the currency in circulation. The implication of this exercise was to reduce the currency in circulation, at least by the amount of old notes held in the war affected states where the exchange did not take place. As a result the country saw a 12 percent decline in the amount of currency with the non-bank public between 1967 to 1968. This was the largest year to year percentage decline in the currency held by the non-bank public in the history of Nigeria since independence. Demand deposits and time plus saving deposits, on the other hand, went up quite considerably by 33 and 40 percent respectively, (see Table

2.2). The large decline in the currency to deposit ratios (both broadly and narrowly defined), from 1967 to 1968, evident from Chart 2.2 as well as Table 2.1, was partly due to the decline in the currency component and partly due to the growth in the various deposits.

Second is the amendment of the Treasury Bills Act in May, 1968, to enable the Government to finance the civil war. The new amendment increased the maximum permissible ceiling on treasury bills outstanding from 50 to 85 percent of the Government's estimated current revenue, (CBN Annual Report, 1968 p. 42). The effect of this amendment was to increase the treasury bills held by the commercial banks. From 1967 to 1968, the amount of treasury bills outstanding held by the commercial and the merchant banks went up by more than 500 percent. As a result the banks' reserves also went up by about 320 percent. The major part of the increase in the banks' reserves was due to the treasury bills, and is evident from the fact that its other component (vault cash plus deposits with the central banks) went up by 21 percent only for the same period.

Since the demand deposits and savings plus time deposits both went up by less than the percentage increase in the banks' reserves, the large increase in the banks' reserve to deposit ratio (both broadly and narrowly defined) from 1967 to 1968 can be indirectly attributable to the increase in the treasury bills held by the banks. The fall in the value of the money multipliers in 1968 can be argued to be mainly due to the increase in the reserve to deposit ratio. The other determinant of the money multiplier (currency to deposit ratio), unlike the reserve to deposit ratios, declined between 1967 to 1968. The effect of a fall in the currency to deposit ratio is to increase and not to decrease the money multiplier.

2.3.2 1970 - 1971

As stated earlier, the Nigerian government borrowed extensively from the commercial banks and other sources, mainly through sales of treasury bills and other like

assets, to finance the civil war. The effect on the commercial banks was to increase their liquidity, since short-term assets like the treasury bills are counted as part of a bank's liquid assets in Nigeria. However, this increase in liquidity did not pose any immediate inflationary problems because the demand for credit was very low.[5] As the civil war ended in January 1970, the economy and the demand for credit started to pick up. Consequently, inflationary pressure started to build up. However the critical moment for the rise in banks' liquidity and the inflationary pressure came when importers in Nigeria deposited a large sum of local currency equivalent to the value of their imports, for which foreign exchange was not allocated. By the end of June 1971, these deposits amounted to about 400 million naira (Nwankwo, 1980). To bring this inflationary pressure under control, the central bank sought to reduce the liquidity of the commercial banks. For the first time ever, the Central Bank of Nigeria (CBN) called for a non-reserve eligible special deposit to be made by the commercial banks. On the 10th June 1971, a directive was issued to all banks whose short-term external liabilities exceed 20 million naira to deposit the equivalent of the excess amount with the Central Bank of Nigeria on or before 30th of that month, (CBN Annual Report, 1971 p. 33).

The year 1971 therefore, witnessed a decline of 63 percent in the treasury bills held by the banks, as the banks cashed them in to meet the special deposit requirement. The effect of this fall in the treasury bills held by the banks was to reduce the banks' reserves by 56 percent. The decline in total banks' reserves in 1971 was mainly due to the treasury bills component, since the other component (vault cash plus balances with the central bank) declined by less than 20 percent. Currency with the non-bank public, demand deposits, and time plus savings deposits all went up modestly between 1970 to 1971, (see Table 2.2). The reserve to deposit ratios (narrowly and broadly defined) declined by almost 60 percent, while currency to deposit ratios narrowly and broadly

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[5] *The demand for credit was low because the civil war slowed down the economic activities in the country.*

defined declined by one percent and three percent respectively, (see Table 2.1). The increase in the money multipliers between 1970 and 1971 of above 40 percent, shown in Table 2.1, was therefore mainly due to the effect of a decline in the reserves to deposit ratios. This is also quite evident from the graphs where the fluctuation in the reserves to deposit ratios are more pronounced than those of the currency to deposit ratios,(see relevant charts).

2.3.3 1973 - 1974

The period covering late 1973 through 1974 was the beginning of the "oil boom" era in Nigeria. The price of a barrel of Nigerian crude oil went up by about 250 percent within a period of about four months (from 4.287 $US in October 1973 to 14.691 $US by January 1974). This increase in the oil price and the resultant increase in revenue affected all the determinants of the money multiplier and therefore the money multiplier itself, although unequally. Currency with the non-bank public went up by 30 percent, while demand deposits and savings plus time deposits went up by 142 and 67 percent respectively. The increase in these variables reflects the monetisation of the oil revenue. The currency to deposit ratio, narrowly and broadly defined, declined by 46 and 36 percent respectively from 1973 to 1974. The total banks' reserves went up by 283 percent. The treasury bills component went up by about 230 percent, while the other component (vault cash plus balances with the central bank) went up by about 400 percent.

The 'oil boom' was only indirectly responsible for the large increase in the 'vault cash plus balances with the central bank component of the banks' reserves. The direct cause was the abolition of the call money scheme on July 1 1974. The call money scheme, set up in July 1967, was designed to provide an investment outlet for temporarily idle funds of the commercial banks and also to provide a means to absorb any immediate shock of liquidity pressure on the money market. Under the scheme, commercial banks and other participating financial institutions kept, temporarily, their

surplus cash with the Central Bank. The Central Bank then invested these funds in short-term money market instruments, usually treasury bills. It, in turn, paid the commercial banks interest at a certain percentage below the prevailing treasury bills issue rate. Abolition of the scheme was due mainly to the following reasons: 1) The Federal Government, the main user of the call money resources, did not desire extra funds since it had enough from the oil revenues. 2) Upsurge in the commercial banks' liquidity increased the demand for the facility, which the scheme could no longer provide.

The reserve to deposit ratio, narrowly and broadly defined, went up by about 60 and 90 percent respectively. That coupled with the decline in the currency to deposit ratio, gave the modest decline in the narrowly and broadly defined money multiplier of 12 and 16 percent respectively from 1973 to 1974.

2.3.4 1981 -1982

The oil glut which started in late 1981/1982 resulted in a decline in prices and output of Nigerian crude oil. Total shipments fell from 701.3 billion barrels in 1981 to 394.7 billion barrels in 1982, while the average price which stood at $39.76 US in 1981 fell to $35.248 US by the end of 1982. The downward swing in the narrowly and broadly defined money multipliers of 25 and 20 percent between 1981 to 1982 shown by Chart 2.1 and Table 2.1, was partly due to the decline in government revenue brought about by the oil market collapse. In the face of the decline in its revenue, the Federal Government, once again, resorted to borrowing through sales of treasury bills. Between 1981 to 1982, the total treasury bills outstanding held by the commercial and the merchant banks went up by about 140 percent. This increase led to about an 85 percent increase in the banks' reserves. The reserve to deposit ratios, narrowly and broadly defined, therefore, went up by 87 and 69 percent respectively. However, this increase was also partly due to the decline in demand deposits of about one percent. The decline in the demand deposits largely represents a shift to income earning savings and time deposits following an increase in the deposit rate from 5.72 to 7.60 percent per annum. The time plus savings

deposits went up by about 20 percent within this period.

The currency to deposit ratios, (especially the narrowly defined one) have also contributed to the decline in the money multipliers. The currency to deposit ratio, narrowly defined, went up by about 10 percent, while the broadly defined one declined by about 0.2 percent. The increase in the narrowly defined currency to deposit ratio was due to a modest increase in currency with the non-bank public of about 9 percent, coupled with the decline in demand deposits stated above.

2.3.5 1985 -1986

The major event that took place in Nigeria in 1986 that affected the whole economy was the adoption of the IMF supported structural adjustment programme SAP in July of that year. The main aim of (SAP) was to correct the distortions to the economy caused by the increase in oil prices in the 1970s. Specifically, SAP seeks to achieve the following objectives:

i) To restructure and diversify the productive base of the economy in order to reduce the dependence on the oil sector and on imports.

ii) To achieve fiscal and balance of payments viability.

iii) To lay the basis for a sustainable non-inflationary growth.

iv) To lessen the dominance of the unproductive investments in the public sector, improve the sector's efficiency and intensify the growth potential of the private sector.

One fundamental strategy for achieving these objectives was the adoption of a realistic exchange rate policy, coupled with the liberalisation of the external trade and payments system. This strategy led to the setting up of the Second Tier Foreign Exchange Market (SFEM), with the aim of bringing about a realistic and sustainable exchange rate for the Nigerian currency (naira), (CBN Annual Report 1986). The operational framework of SFEM is a periodic closed auction system, where the Central

Bank supplies a given amount of foreign exchange and calls for bids from the authorised dealers and thus determines the exchange rate for some periods. In the first bidding session held on the 29th September, 1986, the exchange rate of naira was depreciated by 66 percent with immediate effect, (see chapter 1 for a discussion on the operational details of SFEM).

Since the beginning of the structural adjustment programme, there was increased pressure on the commercial banks' resources for the following reason: 1) The announcement in July 1986 of the government's intention to introduce the SFEM led to a rush by bank customers to obtain credit for the settlement of their foreign obligations in anticipation of the expected substantial depreciation of the value of the naira. 2) As the depreciation took place, the naira price of imported inputs went up quite considerably and led to an increase in the working capital requirements of Nigerian businesses. This also led to an increase in the demand for credit. 3) In August and October 1986, the Central Bank called upon the commercial banks to deposit the naira counterpart of all external commitments with the Central Bank. Customers who could not provide the funds were compelled to seek bank loans. 4) The banks themselves required cash for the foreign exchange bidding sessions. The banks met this pressure for liquidity by discounting their treasury bill holdings.

The value of treasury bills held by the banks (commercial and merchant banks) fell by 65 percent, from 9 billion naira in December 1985 to 3.2 billions by the end of 1986. This had the effect of reducing the banks' reserves by about 53 percent from 1985 to 1986. The component of banks' reserves made up of vault cash plus balances with the Central Bank, however, went up by about 83 percent from 0.824 billion in 1985 to 1.51 billion in 1986. The banks' reserve to deposit ratios, narrowly and broadly defined, declined by 47 and 53 percent respectively. Currency to deposit ratios narrowly and broadly defined, on the other hand, went up by 17 and 4 percent respectively. These increases are basically accounted for by a modest increase in the currency with the non-

bank public of about 5 percent, coupled with a decline in demand deposits of 10 percent. Savings plus time deposits, however, went up by 10 percent, accounting for the lower percentage increase in the broadly defined currency to deposit ratios. Furthermore, it is the treasury bills component of the banks' reserves that is responsible for most of the fluctuations.

The effect of an increase in the currency to deposit ratio is to reduce the money multipliers while that of a decrease in the reserve to deposit ratios is to have the opposite effect. The large change in the money multipliers (an increase in this case), as in almost all of the cases discussed above, was due to the change in the reserve to deposit ratios component rather than the currency to deposit ratios.

The above analyses show that most of the noticeable fluctuations in the Nigerian money multipliers since 1960, are attributable to one form of shock or the other. It therefore, may not be appropriate to draw conclusions regarding the stability/instability of the multiplier based on the year to year fluctuations.

2.4 Forecasting the Currency Ratio, Reserve Ratio, and the Money Multiplier

The stability of the money multiplier, although important, is neither necessary nor a sufficient condition for the ability of the monetary authorities to successfully control the money stock. What is necessary is for the monetary authorities to be able to predict the value a multiplier is likely to take in the future, and change the monetary base accordingly to achieve the desired level of money stock. To test whether the Nigerian money multipliers can be predicted, requires building a model of the multipliers and those of the determinants (currency and reserve ratios) and then testing for the models' ability to forecast the future.

The forecasting accuracy test of the models is carried out in the following manner: Firstly parsimonious models for the ratios and the multiplier, employing part of the whole sample period (1960 to 1987), are found. Secondly, the left out observations are

then forecast using the estimated parsimonious models. A test statistic comparing the within sample and post sample residual variances asymptotically distributed as a $\chi^2(N)/N$ where N is the degrees of freedom is constructed. The null hypothesis tested is that the estimated parameters and the variances in the sample and the forecast period are the same (H_0: $\beta_1 = \beta_2 : \sigma_1^2 = \sigma_2^2$). The test statistic is standardised such that if its calculated value is greater than 2 it is taken to imply a poor ex-ante forecast. In addition to the χ^2 - test, a Chow - Test for parameter constancy between the sample and the forecast period can be constructed.

The determinants of the money multiplier (currency and reserve ratios) are behavioural variables determined by the non-bank public's and the banks' behaviour. The currency to deposit ratio and the banks' reserve to deposit ratio can be modelled as behavioural equations, each determined by a series of explanatory variables. Since the money multiplier is an identity derived from a combination of these two behavioural variables, as shown by equation (2.10) above, it is expressed as a function of the variables determining the ratios.

The models of currency ratio, the reserve ratio, and the money multiplier for Nigeria are presented below.

$$\frac{C_p}{D} = f\,(GDP,\ CPI,\ BBRCH,\ SRT) \tag{2.11}$$

$$\frac{R}{D} = g\,(LRT,\ DRT,\ TBR) \tag{2.12}$$

$$MULT = h\left[\frac{C_p}{D},\ \frac{R}{D}\right] \tag{2.13}$$

Where the variables are defined as follows:

MULT = Annual Values of the Money Multiplier.

$\frac{C_p}{D}$ = Currency to Deposit Ratio

$\frac{R}{D}$ = Banks' Reserve to Deposit Ratio

GDP = Annual Real Gross Domestic Product

CPI = Consumer Price Index

BBRCH = Bank Branches and Offices

LRT = Commercial Banks Lending Rate

SRT = Savings/Deposit Rate

DRT = Discount Rate

TBR = Treasury Bills Rate

Equation (2.11) is the non-bank public's currency to deposit ratio. It is postulated to be a function of the real gross domestic product (GDP), a measure of cost of living (CPI), number of bank branches and offices (BBRCH)[6] and the savings or deposit rate (SRT). As income goes up, the demand for most goods and services are also expected to go up. Following the transactions motive for demanding money, the public's demand for currency to purchase these goods and services is expected to go up. This means that the expected relationship between the currency ratio and income is positive. However, Khatkhate et al (1980) have argued that the relationship will be negative, because individuals and corporations tend to become more efficient in their cash management as their income rises.

The relationship between the currency to deposit ratio, (especially demand deposit) and the cost of living is expected to be positive. The implicit assumption here, as well as in the previous case, is that currency as well as demand deposits are held for transaction purposes only, since these assets do not bear interest. [7] When there is an increase in the price of goods and services, more money (currency and demand deposit) would be needed to maintain the same level of consumption. In Nigeria, one would expect the increase in the currency component to be greater than that of demand deposits. The situation may be different if a broader definition of deposits (savings plus time deposits)

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[6] *This variable is to cater for the development of banking habit and monetisation of the economy.*

[7] *In reality in most countries, demand deposits bear some interest, although considerably less than on the other kinds of deposits. In Nigeria, in the latter part of 1990, it was made mandatory for commercial banks to pay interest on demand deposits.*

is considered. Economic agents may want to increase their holdings of these deposits to hedge against inflation which erodes the value of wealth held in cash and demand deposits. This suggests a negative relationship between inflation and the currency to deposit ratio.

The bank branches and offices, as a proxy for development of banking habit and monetisation in Nigeria, is expected to be negatively related to the currency to deposit ratio. As the banking habit develops people reduce their currency holdings and increase their deposit holdings. An increase in the interest rate paid for deposits is expected to reduce the amount of currency held, since the interest rate is an opportunity cost of holding currency or, in the Nigerian case, a demand deposit as well.

The banks' reserve to deposit ratio is also postulated to be a function of the lending rate (LRT), the discount rate (DRT), and the treasury bills rate (TBR).

A higher lending rate is expected to induce banks to reduce their reserves to take advantage of the more profitable lending, giving a negative relationship between lending rates and the reserve ratio. A higher treasury bills rate would encourage banks to switch from holding other assets to holding treasury bills. Since treasury bills held by the banks are part of the banks' reserves in Nigeria, the banks' reserve to deposit ratio will go up. The relationship between banks' reserve ratio and the treasury bills rate is therefore expected to be negative. A higher discount rate, on the other hand, induces banks to raise their reserve ratio to avoid using the discount window to make up for the legal requirement.

The money multiplier, derived directly from the currency to deposit ratio and the reserve to deposit ratio, is indirectly affected by the variables determining the ratios. Any variable that increases the ratios is expected to have a negative effect on the money multiplier, while the opposite holds for the variables that lead to a decrease in the ratios.

2.5 The Econometric Modelling Technique

The currency to deposit ratios, the reserve to deposit ratios and the ensuing money multipliers, for the purpose of estimation and forecasting future values are specified as dynamic models. Dynamic models involve non-contemporaneous relationships between the dependent and the independent variables. This means that the full effect of a change in an independent variable on the dependent variable is not realised instantaneously, but rather distributed through time. In comparison, in a static model, the dependent variable is taken to be a function of a set of explanatory variables observed at the same point in time with the dependent variable. This implies that the complete effect of any change in the independent variable on the dependent variable is realised within the periodicity of the data.

The relevant estimation equations are formulated as autoregressive distributed lagged models (ADL). Assuming for simplicity that there are k explanatory variables in the model, the general form of the ADL model can be presented as equation (2.14) below, (see Harvey 1990 p. 265).

$$A(L)Y_t = \sum_{i=1}^{k} B_i(L)X_{ti} + \varepsilon_t \qquad (2.14)$$

Where $\left[A(L) = 1 - \alpha_1 L - \alpha_2 L^2 - .... - \alpha_r L^r\right]$ and $\left[B(L) = B_0 + B_1 L + B_2 L^2 + \cdots + B_s L^s\right]$

This formulation has the following advantages. To start with, if the error term (ε_t) in (2.14) is normally distributed, ordinary least square estimates are fully efficient. Secondly, it is easier to use Hendry's approach - a model selection procedure of moving from the general to specific, which is employed in this study. The general to specific procedure requires that a parsimonious model should not be adopted at the beginning of the exercise. Instead, the model should be deliberately overfitted with as many potential explanatory variables as possible, and then a specification search is conducted to arrive at the most suitable explanatory variables. The general to specific procedure becomes more relevant in situations (as in the case of this study) where the theory does not provide with

certainty the variables to be included in the estimating equation. Indeed, Harvey, (1990) has argued that the decision as to whether or not a particular explanatory variable should be included in a model can only be made if it is included in the model in the first place.

There is one fundamental problem with equation (2.14). It is likely to suffer from multicollinearity, since variables and their lagged values are often highly correlated. One way of handling this problem is to reparameterise it into levels and changes, as in (2.15) below, thus ensuring orthogonality of the explanatory variables.

$$\Delta Y_t = (\alpha - 1)Y_{t-1} + \sum_{j=1}^{r-1} \alpha_j^* \Delta Y_{t-j} + \beta_0 \Delta X_t + \beta X_{t-1} + \sum_{j=1}^{s-1} \beta_j^* \Delta X_{t-j} + \varepsilon_t \qquad (2.15)$$

In addition, specifying a model in the form of equation (2.15) separates more clearly the short-run and the long-run effects of an independent variable on the dependent variable. The impact effect (the short-run effect) is represented by the coefficient of the change variable, while the long-run effect is given by the coefficients of the level variables divided by minus the coefficient of the lagged dependent variable ($\alpha - 1$).

2.6 Discussion of the Estimation Results

The general to specific modelling procedure, briefly outlined above, is used to estimate the narrowly and broadly defined currency to deposit ratio, reserve to deposit ratio, and the money multiplier. The starting point of the estimation process is to set the relevant equations (2.11 to 2.13) in the form of equation (2.15) above. The right hand side of each equation contained a one period lagged dependent variable in levels and in first differences, one period lagged level and non lagged first difference of each independent variable. A specification search is then conducted to arrive at parsimonious models.

A number of models of the broadly and narrowly defined currency to deposit ratios are reported in Table 2.3 to 2.3.2 as (CR1) and (CR2), depending on the specification of the dummy variables. The results with the lowest standard errors are those of Table 2.3 which include step dummies. Both narrow and broad models of this table are free of both

first and second order serial correlation as shown by the Lagrange Multiplier Tests (LM1 and LM2). Chi-squared tests for normality failed to reject the null hypotheses that the errors are normal. However, both models could not pass the first-order ARCH-test for heteroskedastic error terms. The calculated chi-squared values are 6.58 and 6.65 respectively, while the critical value at 5 percent is about 5.99. The reported t-values are however, derived from heteroskedasticity consistent standard errors.

All explanatory variables carry the expected signs except the savings rate (SRT). The savings rate both in the short-run and in the long-run has positive effects on the narrowly defined currency to deposit ratios. This seems to suggest that the savings rate does not represent the opportunity cost of holding money in Nigeria. This finding tends to confirm that of Ajayi (1973) that savings deposits in Nigeria are not held for the interest income but rather the other services they provide. The 1968, 1971, and 1986 dummy variables have been dropped from the equations in Table 2.3 because of the low level of their significance in explaining the currency to deposit ratios. In fact, the 1981 dummy is significant only at the 10 percent and above level.

The most important test for the purpose of this study is the test for the ability of the models to forecast the future values of currency to deposit ratios. The calculated forecast Chi-squared value of 1.59 and the forecast period Chow-Test value of 0.44, coupled with the battery of diagnostic tests reported earlier, show that the model for narrowly defined currency to deposit ratio with step dummies has a good ability to forecast the future. It is stated in section 2.4 that if the calculated forecast chi-squared is larger than 2, then the model fails the forecast accuracy test. The calculated forecast chi-squared of 3 for the broad definition of the currency to deposit ratio indicates that the model gives poor ex-ante forecasts of the future. However, a Chow-Test for the forecast period, and the results of the model specification tests dispel any possibility that this model is not stable.

Table 2.3

Currency to Deposit Ratios with Step Dummies (Narrow and Broad Definitions)		
Variables	CR1	CR2
Const.	8.55 (5.07)	9.32 (5.43)
$\Delta Log\ (CR\ 1)_{t-1}$	-	
Log $(CR\ 1)_{t-1}$	-1.15 (-9.07)	- -
$\Delta Log(CR\ 2)_{t-1}$	-	
Log $(CR\ 2)_{t-1}$	- -	-0.80 (-7.02)
Δ Log GDP	-1.05 (-6.26)	-1.23 (-9.72)
Log $(GDP)_{t-1}$	-0.27 (-1.74)	-0.27 (-1.94)
Δ Log BBRCH	-0.66 (-2.60)	-1.06 (-4.09)
Log $(BBRCH)_{t-1}$	-1.23 (-6.93)	-1.58 (-7.98)
Δ Log SRT	0.43 (2.24)	- -
Log $(SRT)_{t-1}$	0.48 (2.89)	- -
Δ Log CPI	0.45 (2.01)	0.69 (2.66)
Log $(CPI)_{t-1}$	0.48 (3.32)	0.93 (6.98)
D1973/74	-0.56 (-6.25)	-0.33 (-4.69)
D1981/82	0.17 (1.52)	0.14 (1.20)
R^2	0.90	0.83
Std. Err.	0.076	0.083
LM-Test 1^{st}-Order Serial Correlation	F(1,16) 0.14	F(1,18) 1.58
LM-Test 2^{nd}-Order Serial Correlation	F(2,15) 1.50	F(2,17) 1.66
ARCH-Test 1^{st}-Order Heteroskedasticity	$\chi^2(1)$ 6.58	$\chi^2(1)$ 6.65
Normality Test	$\chi^2(2)$ 0.88	$\chi^2(2)$ 0.05
Forecast Accuracy Test	$\chi^2(2)/2$ 1.59	$\chi^2(2)/2$ 3.12
Chow-Test for Forecast Period	F(2,15) 0.44	F(2,17) 1.04

Dependent Variables: Δ Log CR1 and Δ Log CR2.
Where CR1= C_p/DD; and CR2= C_p/(DD+TD+SD)
t - Values in parenthesis are calculated from heteroskedasticity consistent error terms.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 2.3.1

Currency to Deposit Ratios with no Dummies (Narrow and Broad Definitions)		
Variables	CR1	CR2
Const.	6.77 (2.53)	9.78 (3.90)
$\Delta Log\ (CR\ 1)_{t-1}$	-	
Log $(CR\ 1)_{t-1}$	-0.78 (-3.49)	- -
$\Delta Log\ (CR\ 2)_{t-1}$	-	
Log $(CR\ 2)_{t-1}$	- -	-0.62 (-3.33)
Δ Log GDP	-0.74 (-2.35)	-1.02 (-3.98)
Log $(GDP)_{t-1}$	-0.68 (-0.68)	-2.34 (-2.34)
Δ Log BBRCH	-0.46 (-0.87)	-0.64 (-1.53)
Log $(BBRCH)_{t-1}$	-1.02 (-2.56)	-1.17 (-3.63)
Δ Log SRT	0.72 (2.29)	- -
Log $(SRT)_{t-1}$	0.75 (2.57)	- -
Δ Log CPI	0.26 (0.72)	0.55 (2.06)
Log $(CPI)_{t-1}$	0.15 (0.53)	0.71 (3.51)
D1973/74	- -	- -
D1981/82	- -	- -
R^2	0.66	0.64
Std. Err.	0.14	0.11
LM-Test 1^{st}-Order Serial Correlation	F(1,18) 0.06	F(1,20) 0.63
LM-Test 2^{nd}-Order Serial Correlation	F(2,17) 0.31	F(2,19) 0.32
ARCH-Test 1^{st}-Order Heteroskedasticity	$\chi^2(1)$ 0.053	$\chi^2(1)$ 0.051
Normality Test	$\chi^2(2)$ 5.72	$\chi^2(2)$ 0.89
Forecast Accuracy Test	$\chi^2(2)/2$ 0.34	$\chi^2(2)/2$ 3.38
Chow-Test for Forecast Period	F(2,15) 0.27	F(2,17) 1.37

Dependent Variables: Δ Log CR1 and Δ Log CR2.
Where CR1= C_p/DD; and CR2= C_p/(DD+TD+SD)
t - Values in parenthesis are calculated from heteroskedasticity consistent error terms.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 2.3.2

Currency to Deposit Ratios with Impulse Dummies (Narrow and Broad Definitions)		
Variables	CR1	CR2
Const.	3.03 (1.41)	8.37 (3.32)
$\Delta Log\ (CR\ 1)_{t-1}$	-	
Log $(CR\ 1)_{t-1}$	-0.68 (-4.16)	- -
$\Delta Log(CR\ 2)_{t-1}$	-	
Log $(CR\ 2)_{t-1}$	- -	-0.56 (-3.26)
Δ Log GDP	-0.54 (-2.27)	-0.92 (-3.81)
Log $(GDP)_{t-1}$	0.07 (0.34)	-0.40 (-2.02)
Δ Log BBRCH	-0.52 (-1.32)	-0.69 (-1.78)
Log $(BBRCH)_{t-1}$	-0.78 (-2.53)	-1.03 (-3.25)
Δ Log SRT	0.75 (2.93)	- -
Log $(SRT)_{t-1}$	0.83 (3.88)	- -
Δ Log CPI	0.21 (0.79)	0.60 (2.38)
Log $(CPI)_{t-1}$	-0.11 (-0.50)	0.60 (2.99)
ΔD1973/74	-0.49 (-4.30)	-0.24 (-2.02)
ΔD1981/82	0.04 (0.30)	0.13 (1.18)
R^2	0.84	0.72
Std. Err.	0.099	0.104
LM-Test 1^{st}-Order Serial Correlation	F(1,16) 0.45	F(1,18) 0.05
LM-Test 2^{nd}-Order Serial Correlation	F(2,15) 2.56	F(2,17) 0.03
ARCH-Test 1^{st}-Order Heteroskedasticity	$\chi^2(1)$ 0.01	$\chi^2(1)$ 0.007
Normality Test	$\chi^2(2)$ 0.43	$\chi^2(2)$ 1.00
Forecast Accuracy Test	$\chi^2(2)/2$ 1.53	$\chi^2(2)/2$ 6.48
Chow-Test for Forecast Period	F(2,15) 0.63	F(2,17) 2.57

Dependent Variables: Δ Log CR1 and Δ Log CR2.
Where CR1= C_p/DD; and CR2= C_p/(DD+TD+SD)
t - Values in parenthesis are calculated from heteroskedasticity consistent error terms.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

A number of models for the broadly and narrowly defined banks' reserve to deposit ratios are presented in Tables 2.4 to 2.4.2. The result of specifying the models with step dummies are in Table 2.4. Besides the dummy variables, only the treasury bills rate and the lending rate are found to be significant in explaining banks' reserves in Nigeria. Both variables carry expected signs. An increase in lending rate reduces the amount of reserves held. Presumably banks, rather than keeping their assets in reserve form, loan them out to take advantage of the increase in the lending rate. A rise in the treasury bills rate encourages banks to switch their funds from other forms of investment into treasury bills. Since the banks' reserves are defined to include treasury bills, any switch from non-reserves assets to treasury bills by the banks increases the banks' reserves. Furthermore, all variables in changes are found to be insignificant in explaining banks' reserves in Nigeria, suggesting that banks in Nigeria adjust to their equilibrium reserve level within a year after a change in either the lending rate or the treasury bills rate.

The step dummy variables representing each of the periods of major disturbances discussed in section 2.3 of this chapter are all quite significant, confirming the analytical conclusions of the section. This, firstly, suggests that the shocks to the Nigerian economy did in fact, affect the reserve to deposit ratios, and secondly, that these effects can be successfully proxied (ex-post) by the use of the dummy variables in the modelling process.[8] Unlike in the case of the currency to deposit ratios, the models in Table 2.4 pass all the regular specification tests including that of heteroskedasticity. The test for the forecasting ability of the models, carried out in a similar manner to the currency to deposit ratio case, indicates that the models can predict the future values of the reserve to deposit ratios satisfactorily. In fact, as indicated by the lower values for the calculated forecast Chi-squared, these models have a better forecasting ability than the ones for the currency to deposit ratios. The diagnostic tests as well as the forecast period Chow - Test

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[8] *It must be borne in mind that the dummy variables represent empirical hindsight, and that ex ante predictability in the face of external shocks may be difficult.*

Table 2.4

Reserve to Deposit Ratios with Step Dummies (Narrow and Broad Definitions)		
Variables	RR1	RR2
Const.	1.20 (1.31)	-0.02 (-0.02)
$\Delta Log\ (RR\ 1)_{t-1}$	-	-
Log $(RR\ 1)_{t-1}$	-0.93 (-6.83)	- -
$\Delta Log\ (RR\ 2)_{t-1}$	-	-
Log $(RR\ 2)_{t-1}$	- -	-0.96 (-7.40)
Δ Log LRT	-	-
Log $(LRT)_{t-1}$	-1.81 (-2.70)	-1.32 (-2.16)
Δ Log DRT	-	-
Log $(DRT)_{t-1}$	-	-
Δ Log TBR	-	-
Log $(TBR)_{t-1}$	0.85 (2.14)	0.61 (1.62)
D1967/68	1.33 (6.04)	1.30 (6.50)
D1970/71	-0.87 (-4.70)	-0.90 (-5.11)
D1973/74	0.27 (1.72)	0.42 (2.78)
D1981/82	0.59 (2.93)	0.43 (2.29)
D1985/86	-0.56 (-2.74)	-0.62 (-3.19)
R^2	0.79	0.80
Std. Err.	0.22	0.21
LM-Test 1^{st}-Order Serial Correlation	F(1, 19) 1.77	F(1, 19) 1.77
LM-Test 2^{nd}-Order Serial Correlation	F(2, 18) 1.62	F(2, 18) 1.16
ARCH-Test 1^{st}-Order Heteroskedasticity	$\chi^2(1)$ 1.04	$\chi^2(1)$ 1.87
Normality-Test	$\chi^2(2)$ 0.31	$\chi^2(2)$ 0.48
Forecast Accuracy Test	$\chi^2(2)/2$ 0.73	$\chi^2(2)/2$ 0.35
Chow-Test for Forecast Period	F(2, 18) 0.36	F(2, 18) 0.28

Dependent Variables: Δ Log RR1 and Δ Log RR2.
Where RR1=Reserves/DD; and RR2=Reserves/(DD+TD+SD).
t-Values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 2.4.1

Reserve to Deposit Ratios with no Dummies (Narrow and Broad Definitions)		
Variables	RR1	RR2
Const.	0.69 (0.48)	-0.14 (-0.10)
$\Delta Log\ (RR\ 1)_{t-1}$	-	-
Log $(RR\ 1)_{t-1}$	-0.31 (-2.12)	- -
$\Delta Log\ (RR\ 2)_{t-1}$	-	-
Log $(RR\ 2)_{t-1}$	- -	-0.32 (-2.13)
Δ Log LRT	-	-
Log $(LRT)_{t-1}$	-0.64 (-0.58)	-0.12 (-0.11)
Δ Log DRT	-	-
Log $(DRT)_{t-1}$	-	-
Δ Log TBR	-	-
Log $(TBR)_{t-1}$	0.29 (0.51)	0.01 (0.02)
D1967/68		
D1970/71		
D1973/74		
D1981/82		
D1985/86		
R^2	0.18	0.17
Std. Err.	0.39	0.39
LM-Test 1^{st}-Order Serial Correlation	F(1, 24) 0.17	F(1, 24) 0.14
LM-Test 2^{nd}-Order Serial Correlation	F(2, 23) 0.34	F(2, 23) 0.48
ARCH-Test 1^{st}-Order Heteroskedasticity	$\chi^2(1)$ 0.94	$\chi^2(1)$ 1.10
Normality-Test	$\chi^2(2)$ 1.01	$\chi^2(2)$ 0.76
Forecast Accuracy Test	$\chi^2(2)/2$ 6.06	$\chi^2(2)/2$ 4.74
Chow-Test for Forecast Period	F(2, 23) 1.76	F(2, 23) 1.39

Dependent Variables: Δ Log RR1 and Δ Log RR2.
Where RR1=Reserves/DD; and RR2=Reserves/(DD+TD+SD).
t-Values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 2.4.2

Reserve to Deposit Ratios with Impulse Dummies (Narrow and Broad Definitions)		
Variables	RR1	RR2
Const.	2.48 (2.58)	1.64 (1.83)
$\Delta Log\ (RR\ 1)_{t-1}$	-	-
Log $(RR\ 1)_{t-1}$	-0.68 (-0.73)	- -
$\Delta Log\ (RR\ 2)_{t-1}$	-	-
Log $(RR\ 2)_{t-1}$	- -	-0.05 (-0.55)
Δ Log LRT	-	-
Log $(LRT)_{t-1}$	-1.91 (-2.61)	-1.30 (-1.92)
Δ Log DRT	-	-
Log $(DRT)_{t-1}$	-	-
Δ Log TBR	-	-
Log $(TBR)_{t-1}$	0.92 (2.38)	0.61 (1.73)
ΔDCW	0.99 (5.77)	1.00 (6.30)
ΔD1973/74	0.37 (1.55)	0.59 (2.65)
Δ D1981/82	0.79 (3.15)	0.65 (2.82)
ΔD1985/86	-0.78 (-2.90)	-0.84 (-3.36)
R^2	0.75	0.78
Std. Err.	0.23	0.22
LM-Test 1^{st}-Order Serial Correlation	F(1, 20) 0.24	F(1, 20) 0.21
LM-Test 2^{nd}-Order Serial Correlation	F(2, 19) 2.06	F(2, 19) 1.07
ARCH-Test 1^{st}-Order Heteroskedasticity	$\chi^2(1)$ 2.44	$\chi^2(1)$ 1.88
Normality-Test	$\chi^2(2)$ 0.40	$\chi^2(2)$ 0.36
Forecast Accuracy Test	$\chi^2(2)/2$ 8.49	$\chi^2(2)/2$ 8.84
Chow-Test for Forecast Period	F(2, 19) 2.13	F(2, 19) 2.16

Dependent Variables: Δ Log RR1 and Δ Log RR2.
Where RR1=Reserves/DD; and RR2=Reserves/(DD+TD+SD).
t-Values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.
DCW: Dummy variable to cater for the Nigerian Civil War. It takes the value of ones for the three years of the civil war and zeros all other times.

Table 2.5

Money Multipliers with Step Dummies (Narrow and Broad Definitions)		
Variables	MULT1	MULT2
Const.	-3.77 (-1.65)	-5.11 (-2.55)
$\Delta Log\ (MULT1)_{t-1}$	-0.31 (-2.15)	- -
Log $(MULT1)_{t-1}$	-0.42 (-2.41)	- -
$\Delta Log\ (MULT2)_{t-1}$	- -	-0.21 (-1.43)
Log $(MULT2)_{t-1)}$	- -	-0.87 (-5.78)
Δ Log GDP	0.70 (2.84)	0.39 (1.73)
Log $(GDP)_{t-1}$	0.34 (1.54)	0.49 (2.56)
Δ Log LRT	-0.90 (-2.60)	- -
Log $(LRT)_{t-1}$	- -	0.28 (1.87)
Δ Log TBR	0.28 (1.97)	0.14 (1.30)
Log $(CPI)_{t-1}$	0.16 (2.30)	-0.45 (-2.21)
D1967/68	-0.43 (-5.59)	-0.35 (-5.17)
D1970/71	0.19 (1.41)	0.20 (1.64)
D1973/74	-0.24 (-2.85)	-0.14 (-1.98)
D1981/82	-0.43 (-5.04)	-0.30 (-4.07)
D1985/86	0.34 (3.55)	0.24 (3.70)
R^2	(0.88)	(0.88)
Std. Err.	0.078	0.069
LM-Test 1^{st} Order Serial Correlation	F(1, 14) 0.30	F(1, 14) 0.98
LM-Test 2^{nd} Order Serial Correlation	F(2, 13) 1.18	F(2, 13) 0.74
ARCH-Test 1^{st} Order Heteroskedasticity	$\chi^2(2)$ 2.58	$\chi^2(2)$ 5.23
Normality-Test	$\chi^2(2)$ 0.647	$\chi^2(2)$ 0.54
Forecast Accuracy Test	$\chi^2(2)/2$ 0.76	$\chi^2(2)/2$ 4.45
Chow-Test for Forecast period	F(2, 13) 0.58	F(2, 13) 0.82

Dependent Variables Δ Log MULT1 and Δ Log MULT2.
Where MULT1=M1/BASE, and MULT2=M2/BASE.
t-Values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 2.5.1

Money Multipliers with no Dummies (Narrow and Broad Definitions)		
Variables	MULT1	MULT2
Const.	-1.14 (-0.83)	-3.27 (-1.60)
$\Delta Log\ (MULT1)_{t-1}$	0.15 (0.63)	- -
Log $(MULT1)_{t-1}$	-0.65 (-2.13)	- -
$\Delta Log\ (MULT2)_{t-1}$	- -	0.36 (1.57)
Log $(MULT2)_{t-1)}$	- -	-0.96 (-3.28)
Δ Log GDP	-0.05 (-0.12)	-0.22 (-0.62)
Log $(GDP)_{t-1}$	0.13 (0.95)	0.32 (1.81)
Δ Log LRT	0.26 (0.47)	- -
Log $(LRT)_{t-1}$	- -	0.34 (1.25)
Δ Log TBR	0.001 (0.02)	0.006 (0.41)
Log $(CPI)_{t-1}$	-0.06 (0.87)	-0.12 (-1.15)
D1967/68		
D1970/71		
D1973/74		
D1981/82		
D1985/86		
R^2	0.28	0.41
Std. Err.	0.16	0.14
LM-Test 1^{st} Order Serial Correlation	F(1, 19) 0.14	F(1, 19) 0.00
LM-Test 2^{nd} Order Serial Correlation	F(2, 18) 0.16	F(2, 18) 0.36
ARCH-Test 1^{st} Order Heteroskedasticity	$\chi^2(2)$ 1.38	$\chi^2(2)$ 0.13
Normality-Test	$\chi^2(2)$ 1.44	$\chi^2(2)$ 0.62
Forecast Accuracy Test	$\chi^2(2)/2$ 3.80	$\chi^2(2)/2$ 7.35
Chow-Test for Forecast period	F(2, 18) 2.07	F(2, 18) 1.69

Dependent Variables Δ Log MULT1 and Δ Log MULT2.
Where MULT1=M1/BASE, and MULT2=M2/BASE.
t-Values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 2.5.2

Money Multipliers with Impulse Dummies
(Narrow and Broad Definitions)

Variables	MULT1	MULT2
Const.	-0.06 (-0.05)	-0.82 (-0.49)
$\Delta Log\ (MULT1)_{t-1}$	-0.25 (-1.31)	- -
Log $(MULT1)_{t-1}$	0.46 (1.49)	- -
$\Delta Log\ (MULT2)_{t-1}$	- -	-0.23 (1.28)
Log $(MULT2)_{t-1)}$	- -	0.33 (1.10)
Δ Log GDP	0.81 (2.28)	0.64 (2.35)
Log $(GDP)_{t-1}$	-0.02 (-0.19)	0.52 (0.35)
Δ Log LRT	-0.38 (-0.93)	- -
Log $(LRT)_{t-1}$	- -	0.09 (0.45)
Δ Log TBR	0.10 (0.53)	0.06 (0.42)
Log $(CPI)_{t-1}$	0.06 (1.02)	-0.05 (-0.61)
ΔDCW	-0.41 (-4.06)	-0.34 (-3.85)
ΔD1973/74	-0.20 (-1.55)	-0.29 (-2.72)
ΔD1981/82	-0.42 (-2.88)	-0.29 (-2.81)
ΔD1985/86	0.42 (2.99)	0.52 (4.57)
R^2	(0.72)	(0.81)
Std. Err.	0.115	0.087
LM-Test 1^{st} Order Serial Correlation	F(1, 15) 0.08	F(1, 15) 0.06
LM-Test 2^{nd} Order Serial Correlation	F(2, 14) 9.78	F(2, 14) 5.70
ARCH-Test 1^{st} Order Heteroskedasticity	$\chi^2(2)$ 0.60	$\chi^2(2)$ 0.91
Normality-Test	$\chi^2(2)$ 0.55	$\chi^2(2)$ 0.70
Forecast Accuracy Test	$\chi^2(2)/2$ 8.79	$\chi^2(2)/2$ 5.87
Chow-Test for Forecast period	F(2, 14) 4.24	F(2, 14) 1.14

Dependent Variables Δ Log MULT1 and Δ Log MULT2.
Where MULT1=M1/BASE, and MULT2=M2/BASE.
t-Values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.
DCW: Dummy variable to cater for the Nigerian Civil War. It takes the value of ones for the three years of the civil war and zeros all other times.

also confirm that fairly stable models can be found for the broad and narrow definitions of the reserves to deposit ratios.

Models for the narrow and the broad definition of the money multipliers, using step dummies, impulse dummies and without any dummy, are presented in Tables 2.5 to 2.5.2. Only four out of the seven explanatory variables given by equations (2.11 and 2.12) are found to be significant in explaining the money multipliers when step dummies are used (Table 2.5). Relevant explanatory variables are the real GDP, the lending rates (LRT), the treasury bills rate (TBR) and the CPI. All the dummy variables are also statistically significant, again confirming the conclusions of section 2.3. The models in Table 2.5 (both narrowly and broadly defined) have passed the regular specification tests as well. With regard to their forecasting ability, the calculated forecast chi-squared show that only the narrowly defined money multiplier can be predicted in Nigeria. This is quite consistent with the results from the determinants of the money multiplier (currency and reserve ratios), where the model for broadly defined currency to deposit ratio, when step dummies were used, is found to have a poor ex-ante forecasting ability. Although a different method is used, the above finding agrees with that of Ojo (1976), that the narrowly defined money multiplier is better for the purpose of money supply control in Nigeria. As in the cases of the models for currency and reserve ratios, a Chow-Test rejects the hypothesis that the forecast period and the other periods cannot be represented by the same model.

The discussion so far has concentrated on the outcome of estimating the models with step dummies. It may be important to examine the degree to which these results depend on the presence of these dummy variables. Furthermore, it may also be interesting to investigate what difference the use of impulse dummies as opposed to step dummies may make to the results.[9]

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[9] *A step dummy assumes that the effect of the shock is permanent, while in the case of an impulse dummy, the effect is temporary. Impulse dummies are obtained by taking the first difference of the step dummies. Initially, the effect of the Nigerian Civil War which went on for three years (1967 to 1970) was represented by two different dummy variables (zeros until 1967 and then ones*

The result of estimating the currency to deposit ratio models with out any dummy variable is presented in Table 2.3.1, while that of using impulse dummies is presented in Table 2.3.2. In both cases there is no dramatic difference with the results from Table 2.3. The models have passed the regular diagnostic tests, with the narrow currency to deposit ratio having a satisfactory ex-ante forecast and the broad one relatively poor ex-ante forecast ability. One difference between the models in Tables 2.3.1, 2.3.2 and the ones in 2.3 is the fact that explanatory variables in the former are relatively weaker.

The result of estimating the reserve to deposit ratios without dummies and one with impulse dummies are presented in Tables 2.4.1 and 2.4.2. Again the models have passed the regular diagnostic tests. Here also the coefficient estimates are weaker than when step dummies were used. The fundamental difference is that, in the former cases the models have quite poor ex-ante forecast abilities. However, in all cases the Chow-test for the forecast period rejects any possibility that the parameter estimates are different between the forecast and the rest of the period.

With regard to the money multiplier, the models without dummy variables are presented in Table 2.5.1 while those using impulse dummies are presented in Table 2.5.2. Although, in both cases the regular specification and validation requirements have been satisfied, all the coefficient estimates with the exception of those on the dummy variables are very weak. Furthermore, the narrow and the broad definition of the money multiplier models, in both cases, show a poor ex-ante forecast.

The robustness of the estimated models of the Nigerian money multiplier and the apparent conclusion that the Nigerian money multiplier is relatively stable and can be forecast with a reasonable degree of accuracy should be treated with a degree of caution, in view of the key role played by the step dummy variables.

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and zeros until 1970 and then ones). Here, one variable - ones for the three years of the civil war and zeros for all other period - is used.

2.7 Controlling the Monetary Base

Earlier in this chapter (section 2.2.1), it was stated that the ability of a monetary authority to control the level of money stock, in the context of the money multiplier model, has two main dimensions. The stability and predictability of the money multiplier and the controllability of the monetary base. So far, only the first part of the issue has been addressed. This section partially addresses the second part, before taking the debate further in the next chapter.

The appropriate starting point for this analysis is a proper definition of the monetary base. According to Balbach & Burger (1976), the monetary base is simply a set of assets that constrains the growth of money stock. In a system where the money stock consists of the sum of banks' liabilities (in the form of deposits) and government's liabilities (in the form of currency), the monetary base is made up of the following: 1) those assets which the consolidated banking sector uses to settle inter-bank debts, and 2) those items, aside from bank liabilities, which are used as money. In most monetary systems, these items take the form of commercial banks' deposits with the central bank and the currency in circulation (both items appear on the liability side of the central banks' balance sheet). This is the 'uses' definition of the monetary base. For the purpose of analysing the controllability of the monetary base, it is necessary also to look at the 'sources' definition. The source of the base money is the algebraic sum of all other assets and liabilities in the central bank balance sheet.

Table 2.6 is the balance sheet of the Central Bank of Nigeria (CBN) as at the end of 1988. According to the above definition, the sources of the monetary base in Nigeria are the sum of all the items in the assets side, minus all the items in the liability side with the exception of currency in circulation and the commercial banks' deposits. As discussed earlier, the treasury bills held by the commercial banks in Nigeria are reserve eligible assets. In this case the amount of treasury bills held by the relevant institutions is to be added to the source definition given above, (Balback and Burger, 1976 p. 6). The sources

of the Nigerian monetary base can be written as equation (2.16) below.

$$FA + GS + TB + LD + OA - CP - GD - SD - FD - OD - OL \qquad (2.16)$$

TB stands for the amount of treasury bills outstanding held by the banks: other variables are defined in Table 2.6.

Table 2.6

Central Bank of Nigeria Balance Sheet
as at 31st Dec. 1988 (millions of naira)

ASSETS		LIABILITIES	
FOREIGN ASSETS (FA)			
Gold	19.80	Paid-up Capital (CP)	334.00
T. Bills $ Bank Balances	3,222.40	Currency in circulations (CL)	10,210.50
Foreign Govt Securities	30.50	Commercial Banks' Deposits (CD)	1,5301.10
TOTAL	3,272.70	Federal Govt's Deposits (GD)	6,302.60
GOVERNMENT SECURITIES (GS)		State Govts' Deposits (SD)	85.60
Treasury Bills	22,350.90	Foreign Deposits (FD)	751.3
Treasury Certs.	3,801.10	Other Deposits (OD)	2,065.00
Others	1,450.50	Other Liabilities (OL)	40,243.30
TOTAL	27,602.50		
LOANS AND REDISCOUNTS (LD)			
Treasury Bills	474.40		
Treasury Certs.	9.60		
Commercial Bills	79.20		
Advances	-		
TOTAL	563.20		
Other Assets (OA)	3,584		
	61,552.40		61,552.40

Sources: CBN Economic And Financial Review March, 1990.

The ability of the Central Bank of Nigeria to control the monetary base amounts to its ability to control the variables in equation (2.16). The foreign assets component of the Nigerian monetary base (FA), is mainly the foreign currency deposits in foreign central banks. It is basically determined by the price and export of crude oil, which constitutes over 90 percent of the country's exports. For example, between 1973 and 1974 the CBN saw its foreign assets go up by over 800 percent from 389 to 3,454 million Nigerian naira, while from 1980 to 1983 it declined by 600 percent. The increase in 1973 to 1974 was due to the first oil price increase, and the decrease in the early 1980s was entirely due to the collapse of the oil price. Since the price and export of crude oil are to a large

extent determined by market forces, and to a lesser extent by the decisions of the OPEC cartel, of which Nigeria is a member, the CBN cannot change the foreign assets at will for the purpose of changing the monetary base.

The amount of government securities held by the CBN (GS), depends on the budgetary operations of the Federal Government of Nigeria. In principle the CBN is free to alter its government security holdings for monetary policy purposes, but not in practice. Quite often, contrary to its better judgement, the CBN has been a vehicle for financing the federal government deficits both directly and indirectly.

Indirectly, the CBN is often pressured by the Federal Government to maintain a cheap money policy to keep the cost of deficit financing down. In 1964, the Central Bank's attempt to raise the treasury bills issue rate, in the interest of currency stability, was abandoned because of the Government's opposition to any increase in the cost of its borrowing. Since then, until the dramatic increase in the government's revenue due to crude oil exports in the 1970s, the Federal Government financed most of its expenditures through internal borrowing. After the oil price collapse, against the Central Banks' advice, the Government resorted back to heavy deficit financing for its operations.

Directly, the Central Bank has to accept all government securities issued but not subscribed for by the commercial banks and other non-bank institutions. As a result, in most years the Central Bank subscribes for over 50 percent of the treasury bills issued. For example, in 1988 and 1989, over 80 percent of the issues were subscribed for by the Central Bank.

Although the Central Bank has the power to use open market operations to change the amount of government securities it is holding, in practice, open market operations in the traditional sense of the term have never been used in Nigeria. The buying and selling of government securities by the Central Bank, which has been going on since its inception, was aimed at raising funds for the government rather than influencing the abilities of the Nigerian financial institutions to create money.

The amount of treasury bills held by the commercial banks can also be controlled in principle. To make the commercial banks hold more, the treasury bills rate would have to be increased. However, as mentioned earlier, the Central Bank does not have a free hand in adjusting the rates of return on government securities for monetary policy purposes.

The loans and discounts (LD) component of the monetary base is within the complete control of the Central Bank of Nigeria. It has been using the minimum rediscount rate for monetary policy purposes since 1962. Except for the period between 1968 to 1975, the minimum rediscount rate has been constantly changed throughout Nigeria's post independence history. Other assets (OA), which is mainly composed of fixed assets like buildings, vehicles, etc., cannot be altered for the purpose of changing the monetary base.

Almost all of the variables on the liability side of the Central Bank's balance sheet, which appear in equation (2.16), are not within the control of the monetary authorities. It is inconceivable for the Central Bank to change its paid up capital (CP) for monetary policy purposes. The Federal Government's deposits (GD), the state governments' deposits (SD) are determined by the revenue the governments can generate in any given year. The Central Bank cannot for example, change the interest rates on these deposits or provide other incentives to entice the governments to deposit more. This statement equally applies to the foreign government deposits with the Central Bank of Nigeria (FD). Other deposits (OD), which includes deposits of government parastatals and other institutions, cannot be controlled by the Central Bank at will either. In sum, the Central Bank of Nigeria does not seem to have much control over the components of the monetary base.

The analysis in this chapter so far, implicitly assumes that the monetary base is exogenous which may not be true. A group of economists known as the "Post-Keynesians" believe that the monetary base and the money stock are both endogenously

determined by the public's demand for it. The monetary authorities, therefore, cannot control either at will. A detailed analysis of this contention, plus the short-comings of the money multiplier approach to the money stock determination is taken up in the next chapter.

2.8 Summary and Conclusions

According to the money multiplier model of money stock determination, the money stock at any given point in time is equal to the money multiplier times the monetary base. The money multiplier is an identity derived from the currency to deposit ratio and the reserve to deposit ratio, while the monetary base is basically the sum of currency held by the non-bank public and the reserves of the deposit money banks.

A simple observation of the data and the graphs of the money multiplier, the currency to deposit ratios, and the reserve to deposit ratios for Nigeria shows that their yearly values have experienced some major fluctuations since 1960. It is therefore, tempting to conclude that the money multiplier and its determinants are unstable and as such not predictable. However, closer observation reveals that most of the major fluctuations were due to unpredictable internal or external shocks.

Stability of the money multiplier and its determinants is not an end in itself. What is of importance is the ability of the Nigerian monetary authorities to predict the future value of these variables. Using econometric models, where the shocks are taken into consideration through the use of dummy variables, it is found that the Nigerian monetary authorities may be able to forecast with a reasonable degree of accuracy, the values of the money multiplier and its determinants in the future. This conclusion was arrived at after step dummies were used to capture the shocks. Estimating without dummies, and with impulse dummies could not produce similar results. Therefore, the stability and predictability of the money multiplier is open to question. With regard to the monetary base, evidence does not seem to support that the Central Bank of Nigeria can control the

variables that make up the monetary base. This may be because the monetary base is endogenous. The detailed analysis of whether the monetary base is endogenous is taken up in the next chapter.

Chapter 3

Critique of the Money Multiplier Approach and the Endogeneity/Exogeneity of the Monetary base and the Money Stock in Nigeria

3.1 Introduction

In the last chapter the ability of the Nigerian Central Bank to change the money stock for monetary policy purposes, was analysed in the context of the money multiplier approach. Specifically, the central issues of the approach - the stability and how easily the money multiplier can be predicted, plus the controllability of the monetary base were looked at. However, it is well known that the theory behind the analysis of chapter 2 (the money multiplier analysis of money supply determination) has been found to be deficient, (see for example Goodhart, (1984), (1989)).

The aim of this chapter is to discuss some of the deficiencies of this approach and present alternative methods of analysing the money stock determination. Furthermore, the issue of the endogeneity of the monetary base and the money stock, briefly touched on at the end of the last chapter, is more thoroughly analysed. The outline of the rest of the chapter is as follows: A brief review of the money multiplier theory of money supply determination is carried out in section (3.2). Section (3.3) presents some of the criticisms made against the money multiplier approach as a theory. Section (3.3.1) briefly outlines the portfolio balance model of money supply determination believed to correct some of the deficiencies of the money multiplier approach. A discussion of the critical issue of appropriateness or otherwise of assuming the monetary base as exogenously fixed by the central bank is carried out in section (3.3.2). Section (3.4) looks at the issue of endogeneity/exogeneity of the monetary base and the money stock, paying close attention to the debate between the Monetarists and the Post-Keynesians. In section (3.4.1), a

possible way of empirically testing the issue of exogeneity/endogeneity of the monetary base and the money stock is explored. Section (3.4.2) looks at the Granger-Sims causality test, while section (3.4.3) discusses the outcome of applying the Granger-Sims causality test to Nigerian data. Finally, the summary and conclusion to the chapter is presented in section (3.5).

3.2 The Money Multiplier Approach

The money stock, at a given point in time, is usually defined as the sum of currency with the non-bank public and the deposits with the commercial banks. In Nigeria, the relevant deposits for the purpose of defining money supply is net of the Federal Government deposits. Depending on whether a narrow or a broad definition of money is of interest, deposits with the commercial banks may be just demand deposits, or may include savings and time deposits. Whatever definition is used, the money supply process mainly involves three parties; namely the commercial banks, the non-bank public and the monetary authorities.[1]

All deposits are liabilities of the commercial banks, and assets to the non-bank public, while the currency component of the money stock is the liability of the monetary authorities. Although in less financially developed economies, currency could be a major proportion of the total money stock, it is seldom, if ever, used for the purpose of changing the money stock. This does not mean that the role of the monetary authorities in the money supply process is less important, because the monetary authorities act through the deposit component as well.

The commercial banks play the most important role in the money supply process through the deposit creation activity described at the beginning of the last chapter. The role of the non-bank public is to trigger this deposit creation activity by making the initial deposit and also enable the process to continue by borrowing from the commercial banks.

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[1] *The terms "monetary authorities" and "the central bank" are used interchangeably*

The monetary authorities' role is an indirect one. By using different kinds of measures, including a direct control, it can speed up or delay the credit creation process.

In the previous chapter, the Nigerian money supply process was examined using the money-multiplier formulation of money supply determination. The money stock equation utilised is restated below as equation (3.1)

$$M = \left[\frac{(1 + C_p/D)}{(R/D + C_p/D)}\right] \cdot H \tag{3.1}$$

This equation is derived from an algebraic manipulation of two identities. Namely, the money stock is equal to the currency with the non-bank public plus the deposit liabilities of the commercial banks ($M \equiv C_p + D$), and the monetary base is equal to the currency with the non-bank public plus the banks' reserves ($H \equiv C_p + R$). The money stock equation (3.1) has two components - the money multiplier and the monetary base. The money multiplier is made up of the non-bank public's currency to deposit ratio (C_p/D) and the banks' reserve to deposit ratio (R/D). The behaviour of the banks and the non-bank public are superficially incorporated into the money supply process through the money multiplier. The behaviour of the other agent, the monetary authorities, is incorporated through the monetary base, which is basically made up of their net liability items.

The total quantity of money in circulation is viewed as resulting from the joint decisions of the public, the banks and the monetary authorities. The money stock varies directly with the monetary base and inversely with the (C_p/D) chosen by the public and (R/D) chosen by the banks.

A change in the money supply for monetary policy purposes within the money multiplier framework requires, for a given stable currency and reserve ratios (and therefore, a stable money multiplier), a change in the monetary base in the desired direction by the desired amount. If, on the other hand, the ratios are not stable, the authorities are required to counter the effect of such variability by changing the monetary

base over and above what is required to achieve the desired level of money stock if the ratios and the multiplier were stable. This approach to money supply determination assumes that the monetary base is exogenously controlled by the monetary authorities and by implication the money stock is also exogenously determined.

3.3 Deficiencies of the Money Multiplier Approach

The use of the money supply equation, in the context of the money multiplier approach, as a theory of money supply determination has been criticised on many grounds. Some economists (exemplified by Goodhart, 1984) argue that the money stock equation (3.1) is not an adequate specification of a theory of money supply determination because it is an identity. It simply describes the movement in the money stock without providing much behavioural theory of its determination. As such, its use will tend to obscure the proper role of the main agents (banks and the non-bank public) in the money stock determination process. The following quotation from (Goodhart, 1984 p. 188) explains this point:

> *"..... it causes a complete failure to comprehend the proper role of the banks and the public in the dynamics of the money supply process. The portfolio adjustments of the banks apparently play no role in the process except in so far as they may seek to alter their reserve ratios. The public's asset preferences are seemingly irrelevant to the determination of the money stock, except in so far as they seek to alter their cash/deposit ratio"*

This particular shortcoming of the money multiplier approach culminates in ignoring the very important role played by the relative price of assets (yields) movements in the adjustment process that leads to the final desired level of the money stock, after a change in the monetary base. For example, if there is a desire to increase the money stock, the monetary authorities can buy government securities in the open market. This will provide the non-bank public with excess cash, which they deposit with the banks. The banks, from their sales of securities, together with the deposit they receive from the non-bank public, would experience an increase in their free reserves. According to the deposit multiplier analysis, this will trigger off the deposit/credit creation activity. There

is however an intermediate step which has not been made explicit. When the monetary authorities start buying up securities, for a given supply, the price of securities will go up relative to other assets. An increase in the price of securities is equivalent to a reduction in their yield. Therefore, the non-bank public will substitute away from securities into bank deposits, while banks substitute away from securities into loans. The ultimate end is to increase the money stock - defined as the sum of currency and bank deposits.

3.3.1 The Portfolio Balance Approach

One solution to the above mentioned shortcoming of the money multiplier approach is to use a model which explicitly takes into account the portfolio adjustments of the main agents (the banks, the non-bank public, and the monetary authorities) as the relative prices of assets are altered. The portfolio model suggested by Goodhart 1984 is outlined below:

$$W = D + C^p + DB^p + FB - L \tag{3.2}$$

$$X_i/W = f\,(r^D,\ r^{DB},\ r^{FB},\ r^L,\ W,\ Z) \tag{3.3}$$

$$D_t + K = R + DB^b + L \tag{3.4}$$

$$r^D = f\,(r^L,\ r^{DB},\ R/D,\ RR) \tag{3.5}$$

$$r^L = f\,(r^{DB},\ R/D,\ RR) \tag{3.6}$$

$$R = f\,(r^{DB},\ D,\ RR) \tag{3.7}$$

Equations (3.2) and (3.3) represent the behaviour of the non-bank public. The non-bank public is assumed to hold its wealth (W) in the form of the following assets: Bank deposits (D), Currency (C^p), Domestic bonds (DB^p), Foreign bonds (FB), and a liability in the form of loans from the banks (L). The proportion of the non-bank public's total wealth held in any one of the assets and the liability listed above is given by equation (3.3). This proportion (X_i/W) depends on a vector of own and other assets' rates of return, the wealth variable, and a vector of other independent variables (Z). The assets are assumed to be gross substitutes and, therefore, each asset is positively related to its own rate of return, but negatively related to the other assets' rate of return. Generally, the non-bank public is assumed to allocate its stock of wealth in response to changes in

the interest rate which it takes as given.

The behaviour of the banks are represented by equations (3.4) to (3.7). Unlike the non-bank public, the banks act both as price setters and price takers. The banks set the the rate on the loan they give and accommodate any demand that arises. Similarly, they set the rate on the deposits and accept all money placed with them at that rate. The banks however, would have to act as price takers in deciding their desired holdings of reserve assets and bonds. Equation (3.4) is the banks' balance sheet constraint, where the total liability (made up of deposits (D) plus non-deposit liabilities (K)), is equal to the total assets (composed of their reserve assets (R), their domestic bonds holding (DB^b) and of course the loans they advance to other parties (L)). Equation (3.5) states that banks, in setting the rate they are ready to pay on deposits, will take into account the rate they will earn when the money taken as a deposit is invested in bonds, loans, etc. The other determinant is the degree of liquidity of their assets, represented by the total reserve to deposit ratio (R/D) and the reserve requirement (RR). The higher the rate on loans and on domestic bonds, the higher will be the rates banks will be prepared to pay for the deposits. A high reserve to deposit ratio means that the banks are not pressured for funds and therefore they will be prepared to pay less to attract deposits. However, the converse will be true if the required reserve ratio (RR) were to go up. An increase in (RR) will reduce the liquidity of the banks. To attract more funds the banks would have to raise the deposit rate.

The lending rate fixing activities of the banks is represented by equation (3.6). The rate charged on loans they advanced to the public is assumed to depend on the rates of return on alternative assets, and the liquidity of the banks' portfolios. For example, if the rate of interest on domestic bonds goes up, banks will demand an equally high rate for the advances they make. Otherwise, they can make more by investing in bonds. The more idle funds the banks have (higher R/D and lower RR), the more they will want to give out in loans. This can only be achieved with a lower lending rate.

Equation (3.7) describes the behaviour of the banks with regard to reserve assets holdings. The amount of reserve assets held by the banks is assumed to depend on the domestic bonds rate relative to the rate of return on reserve assets (fixed at zero), the required reserves and the total liquid assets available to the banks. A high bonds rate will discourage banks from keeping reserves over and above what is required by law, since reserve assets do not earn any rate of return. The total demand for reserves is expected to go up when the minimum reserve ratio is increased. Similarly, all other things held constant, a high level of liquid assets may encourage banks to hold more reserve assets.

In such a model, an increase in the relative yield of bonds as a result of open market activities of the monetary authorities will have the following effects: First of all, it will encourage the public to substitute away from bank deposits into bonds, and thus put pressure on bank reserves. However, the degree to which this substitution takes place (shifting away from deposits into domestic bonds) is conditional on the mobility of capital into and out of the country. If capital is reasonably mobile, it is possible for residents to substitute away from foreign bonds into domestic bonds, rather than from their deposits. In this case, the effect of the open market operation will fall on the international capital flows, and the foreign exchange reserves rather than on the domestic money stock. Secondly, even if the monetary authorities succeed in encouraging the public to substitute away from deposits, the banks can counter that by raising the deposit rate and by bidding for more deposits. For the banks to maintain their profit margin, they will equally raise the lending rate. An increase in the lending rate could reduce the demand for loans and thus reduce the money supply as intended by the monetary authorities. However, if the interest elasticity of demand for loans is small (inelastic demand for loans), the banks can successfully bid for more funds and continue to expand their loan advances, and thereby undermine any efforts to reduce the money stock.

Although the portfolio balance model outlined above which explicitly takes account of the behaviour of the major agents is an improvement over the multiplier approach, its

applicability to the developing economies like that of Nigeria is very limited. In Nigeria, and in many other developing countries, the financial market is limited in scope, (see chapter 1 for a discussion). Moreover, yields on the limited financial assets are quite often not determined by the interaction of demand and supply, but rather artificially fixed by the authorities.

3.3.2 Exogeneity of the Monetary Base

Another major deficiency of the multiplier approach is the fact that it takes the monetary base as given (assumed to be exogenously fixed by the monetary authorities). By taking the monetary base as given, it is implicitly assumed that the authorities have been controlling this aggregate or are intending to do that in the future. Yet they may have been in fact using the interest rate as a monetary policy target. It has been discussed in chapter 2 that the Nigerian Monetary Authorities have been using the interest rate as a target. It is therefore necessary to empirically investigate whether monetary authorities have actually used the monetary base as a policy target rather than to assume it a priori. Even if it has been shown that a given authority uses the monetary base as the policy target, it is wrong to take a policy target as exogenous.

Exogenous variables are those whose values are determined outside the system, while policy targets are control variables whose value the authorities, at the very center of the system, attempt to set. To treat a policy target as an exogenous variable implies that the authorities do not alter their control variable in response to developments in the macro-economy, (Goodhart, 1984). Policy targets generally are not independent of past occurrences and developments in the economic system. Policy variables or targets are changed mainly to steer the economy either away from the past direction into a new direction, or to keep to the same course.

The monetary base, either used as a policy target or not, always changes in reaction to or to serve a certain purpose. The most appropriate line of analysis is to investigate the factors which determine it rather than to take it as given, as the multiplier analysis

does. The appropriate starting point, according to Goodhart, 1984, p 189, is to look at how government deficits are financed. This line of enquiry is most relevant to Nigeria where, as stated in chapter 2, that the Central Bank is a major source of the Federal Government deficit financing. Generally, a government deficit is financed either by sales of government debt to the non-bank public, sales of foreign exchange reserves, or by borrowing from the banking system including the central bank. This last action has the effect of directly increasing the monetary base, (Pierce and Tysome, 1985). The government financing constraint can be written as equation (3.8) below:

$$DEF + MAT = MGD + NMGD + FE + \Delta H \tag{3.8}$$

According to this equation, the total financing requirement of the government (made up of the government deficit at period t (DEF) plus the additional finance required to repay maturing debt (MAT)) should have to be met by one or all of the following: sales of marketable government debt (MGD), sales of non-marketable government debt (NMGD), sales of foreign exchange reserve (FE) and the monetary base expansion (ΔH). Equation (3.8) can be rearranged to arrive at (3.9).

$$\Delta H = (DEF + MAT) - (MGD + NMGD) - FE \tag{3.9}$$

Equation (3.9) is an alternative definition of the source of the monetary base to the one analysed in the last chapter. In the former case, the central banks' balance sheet was used as a starting point, while in this case the starting point is the government deficit financing constraint.

The ability of a monetary authority to change the monetary base (ΔH) can be analysed in a similar manner to section (2.7) of the last chapter, by investigating the degree to which each element on the right hand side of equation (3.9) can be altered at will. As discussed in the last chapter, the Central Bank of Nigeria cannot change the foreign element (FE) at will. Changes in this variable depend on the current and capital account balances of the balance of payments. Neither can the Nigerian Central Bank control the level of the government deficit (DEF), and the additional finance required to

pay maturing debts (MAT). However, the Central bank of Nigeria can alter the levels of marketable and non-marketable government deficits (MGD and NMGDF).

Although it is important to know whether the monetary authorities can control the elements that make up the monetary base, what is of interest for the present analysis is to realise that the authorities do not change the monetary base directly. Instead, they alter the conditions in the government debt market by intervening quantitatively or price-wise. These interventions change the relative prices of assets and bring about portfolio readjustments in the manner described earlier in this chapter. It is portfolio readjustments that bring about changes in the monetary base, (Goodhart, 1984, p. 193).

The above analysis seems to suggest that the Nigerian monetary authorities may be able to change the monetary base. However, this change arises as a byproduct of the Federal Governments fiscal activities and not as a result of a deliberate act to achieve a certain level of money stock. Moreover, even if the monetary authorities do want to change the monetary base for monetary policy purposes, in a credit money economy which most modern economies are, there is an asymmetry in their ability to change the monetary base and thus the money stock. The authorities can increase but not decrease the monetary base, (Moore, 1988). In a country where a secondary security market exists, and there is a desire to increase the monetary base and the money stock, the central bank can purchase securities in the open market. The public who receive the proceeds of the sales will deposit it with the commercial banks. Since the required reserve ratio is always less than 100 percent, the level of free reserves in the commercial banks will go up. Given that banks are profit maximisers, these free reserves will be given out in loans, rather than being kept in the form of non-earning assets - reserves, and in the process increase the money stock.

When the central bank sells securities, with the intention of decreasing the level of the monetary base and thus the money supply, it will drive non-borrowed reserves below the level of required reserves. However, this may not lead to a reduction in the amount

of loans given by the commercial banks. Firstly, some loan arrangements are such that the banks undertake to provide a customer with a line of credit which does not have to be used at once. In such a case, the undisbursed amount of the total commitment would have to be supplied even though the banks' reserves may have fallen. Secondly, if the demand for loans is rising when open market purchases of securities are undertaken (this is often the case since if the demand for loans is falling, there will be less reason to try and reduce the money stock), the banks will find alternative sources of funds to satisfy this demand. The banks, for example, can turn to the discount window of the central bank. The central bank being a lender of last resort cannot reject the demand for funds by the banks, otherwise it could lead the economy into financial crises. However, the central bank has one tool which it can use, that is, it can increase the discount rate, but this will in turn increase the interest rate at which the banks make advances. The end result of the central bank's sales of securities is to increase the interest rate and not to reduce the amount of loans being made, and therefore, the money supply.

The central bank may also face some difficulties in changing the monetary base in the long-run, if the country is a small open one characterised by a fixed exchange rate regime. Changes in the domestic component of the monetary base are likely to be met by an equal but opposite change in the foreign component, such that the monetary base remains unchanged.

By using the central bank's balance sheet, the monetary base has been shown in the last chapter to be equal to the sum of the net foreign assets and the net domestic assets of the central bank (NFA + NDA). The net foreign assets are mainly the foreign exchange reserves of the central bank, while the net domestic assets are made up of the amount of government securities, plus other assets like bills discounted, held by the central bank. If the central bank sells its holding of government securities with the intention of reducing the monetary base and the money stock, the immediate effect is a fall in the level of the domestic component of the monetary base. However, for the sales of the securities to go

through, the price would have to come down and thus the interest rate go up. A high interest rate will discourage investment, reduce income and imports of goods and services. For a given amount of exports, this will improve the current account balance of the country. The increase in the domestic interest rates, for a given level of foreign interest rates, attracts foreign capital and thus improves the capital account balance. The high level of the domestic interest rate will therefore end up improving the balance of payments of the country. In a fixed exchange rate regime, this will translate into an increase in the foreign currency reserves of the central bank - the foreign component of the monetary base.

Under certain assumptions (no sterilisation of balance of payments deficits and surpluses, etc.), the balance of payments will keep on improving and the foreign component of the monetary base will keep on increasing until the initial decrease in the domestic component of the monetary base is completely offset. According to the monetary approach to the balance of payments theory, the offset to the domestic component of the monetary base by the foreign component is complete, implying that any effort by the central bank to increase the monetary base will be futile. Whether in actual fact this offset is complete or not is an empirical matter, and chapters (5) and (6) will investigate the degree to which this offset occurs in Nigeria.

3.4 Endogeneity/Exogeneity of the Money Stock

The analysis in this chapter so far, does not dismiss outright the money multiplier approach and its main assumption that the monetary authorities can, to some extent, control the monetary base and thus the money stock. Instead, the multiplier approach is seen to have some non-fatal flaws that can be corrected. Goodhart, 1975, p. 103 states that

> *"....My objection to the multiplier analysis is that, while it is correct, indeed it is true by definition, it lacks the behavioural content of the portfolio approach"*

The main conclusion of the money multiplier as well as the portfolio approach to money

supply determination (the monetary authorities can to a certain extent determine the money supply through the monetary base), is completely rejected by a group of economists classified as the "Post-Keynesians".[2]

The central contention of the Post-Keynesian theory of money supply[3] is that there is a distinction between the money supply in a commodity money economy and that in a credit money economy. In a commodity money economy, money may, for example, consist of precious metals like gold and silver, paper money convertible to such precious metals or paper money backed by fiat. In all these cases, the quantity of money has an independent supply function since there are distinct costs associated with its production. Money supply in a commodity or fiat money economy, therefore, can be increased independently of the demand. For example, new gold discoveries or a balance of payments surplus will automatically increase the money stock in a gold standard type economy. The approaches to money supply determination where the money stock is assumed to be exogenous and, at least in principle, can be controlled by the central bank are appropriate to this kind of economy, (see Kaldor 1980, Kaldor 1970, Moore 1988, chapter 1, Moore 1986, for instance).

The situation may be quite different when looking at a credit money economy, which describes most modern economies. Credit money mainly consists of I.O.Us of the commercial banks (deposits). This type of money, according to Moore, 1989, has no supply function in the production sense since its cost of production is insignificant. It comes into existence as a result of bank lending and is extinguished through repayments of bank loans. In other words, credit money is created as a by-product of new loans granted by the deposit money banks. Bank loans and the ensuing deposits they create are increased by the initiatives of the borrowers. Banks are basically in a business of selling

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[2] *The most prominent among this group are Nicholas Kaldor, Basil Moore, Sydney Weintraub, Paul Davidson, to mention but a few*

[3] *The term theory here is not used in the strict sense of the word, differences abound among the Post-Keynesians, (see for example, a survey by Jao, 1989).*

credit, and like any other business how much of the product they sell depends on the demand for the product. The demand for bank loans is mostly from business firms. Firms typically have to pay their factors of production - especially labour before they realise the proceeds from the sales of the final goods. They often turn to bank loans to satisfy this need for funds, (Moore 1988). The proceeds of the loan are used to pay the factors of production, who then deposit it with the banks. The bank loan will therefore, reappear as deposits on the liability side of the banks' balance sheets. Money supply in a credit money economy, therefore, varies in direct response to changes in the public demand for bank loans.

An increase in the monetary base, defined as the sum of currency in circulation plus commercial banks' reserves, follows directly from an increase in the commercial banks' deposits brought about by an increase in the demand for credit. In most countries, a certain percentage of all deposits would have to be kept as reserves by law. An increase in the commercial banks' deposits, therefore, increases the total commercial banks' reserves and thus the monetary base. This means that the monetary base is also endogenous, indirectly determined by the credit demand.

Unlike the commodity or fiat money economy, the monetary base and the money stock in a credit money economy are always endogenous, responding only to a change in demand for credit. The central bank can neither change the monetary base nor the money stock at will, as believed by the proponents of the multiplier approach. In fact, when the commercial banks get into a liquidity squeeze as a result of an increase in credit demand from their customers, and they have lent out in excess of their free reserves, they turn to the central bank for funds to make up their reserves requirements. The central bank in its role as the lender of last resort and the guardian of the banking system of a country has no choice but to accommodate the commercial banks' demands. This also indicates that the reserves of the commercial banks (and thus the monetary base) and the total credit supply (indirectly the money stock) change passively in response to credit demand and

not to the desires of the central bank.

The only likely tool of monetary base and money stock control open to the central bank is the price of credit. It can increase its discount rate which indirectly affects the demand for reserve money and the interest rates charged by the commercial banks on loans they give to the public.

The central bank, together with the commercial banks, set the interest rate and at that rate they supply all the amount of credit demanded. The money supply curve is, therefore, believed to be horizontal in the money and interest space. This gives the Post-Keynesians their other name - "The Horizontalists". Furthermore, it is argued that the power of the central bank to change the money stock, using the interest rate, is very limited. The interest elasticity of money demand is believed to be very small, and therefore, if the central bank desires to reduce the money stock through a reduction in the money demand, it would have to raise the interest rate by a considerable amount, which will end up disrupting the financial markets, (Lavoie, 1984).

Other Post-Keynesians (for example, Davidson and Weintraub, 1973) take a middle ground between the assertion that the monetary base and the money stock are completely exogenous and can be controlled by the authorities at will, and the assertion by the other Post-Keynesians that these variables are completely endogenous. To them, a change in the money stock for example, can have both exogenous and endogenous components. The most important endogenous cause of an increase in the money stock is the increase in money wages, determined through collective bargaining. An upward change in money wages will increase the cost of production and with it the demand for money by firms. The central bank will have to accommodate such demands. With the increase in money wages, unless productivity increases, there will be a decline in employment (increase in unemployment). Unemployment is often socially unacceptable, and therefore the central bank (not immune to political pressure) would expand the money supply by an amount more than necessary to cover the increase in demand due to the initial wages increase.

The extra money supply to cover unemployment is therefore the exogenous component of the money stock, (Davison and Weintraub, 1973, Weintraub, 1980).

3.4.1 An Empirical Test

The monetarist's position on the exogeneity/endogeneity of money is that, the nominal money stock is always exogenous. Appealing to the quantity theory of money, they argue that changes in the nominal income and prices almost always arise as a result of changes in the nominal supply of money, (see for example, Friedman, 1971). Furthermore, the money supply process is believed to be explained by equation (3.1) above. According to this equation, the money stock (M) is basically determined by the monetary base (H). The implication of this, coupled with the statement that changes in nominal income are brought about by changes in the nominal money, is that causality runs from the monetary base to the money stock (M) and then to nominal income (Y) [$H => M => Y$].

The Post-Keynesians' views, briefly outlined earlier, is that the converse is the case. In other words, they believe that causation runs from income to money, and then from money to monetary base [$Y => M => H$]. Any variable that leads to an increase in credit demand[4] will also lead to an increase in credit money, as banks automatically try to accommodate such a demand. And as explained above, this will lead to an increase in the monetary base as well. Although not explicitly stated, Lavoie (1984) is of the view that the Post-Keynesians envisage an equation of the following nature: H = (1/u) M, where H, u, and M are as defined earlier, while the term (1/u) is the credit divisor.

An empirical test of endogeneity/exogeneity of the money stock is based on what actually obtained in the past and it takes one or all of the following forms: (see Jao 1989

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[4] *An increase in money wages or in the price of raw materials will cause business borrowers to demand more short-term credit for working capital purposes. Expectations of rising financial asset prices will lead to credit demand for speculative purposes, with a view to reaping anticipated capital gains, (Moore 1988, chapt. 7). An increase in income will increase credit or money demand for transaction purposes.*

for a survey)

i) Testing causality between money and income. The essence here is either to affirm the monetarists contention that money, which they assume to be exogenous, causes income, or to deny this contention. In which case money is endogenous. This is the most widely used empirical test for the endogeneity of the money supply.

ii) Testing causality between money and money wages. Causality running from money wages to money supports the Post-Keynesians' view that an increase in money wages increases demand for credit, which leads to an increase in the supply of credit and therefore, money.

iii) Testing money - monetary base causality. As briefly outlined above, the monetarists believe that the monetary base causes money while the Post-Keynesians believe that the causation runs from money to monetary base. Causality running from money to monetary base may imply that the central bank did not change the monetary base exogenously to achieve a certain desired level of money stock, but rather played a passive accommodating role of supplying bank reserves as often as required.

A money - monetary base causality test is the most relevant when the aim is to examine the ability of a central bank to change the money stock using the monetary base. In this section of the chapter, the Granger-causality test is utilised to determine whether the Central Bank of Nigeria has in the past actively used the monetary base to change the money stock, or has been passively accommodating the demand for reserves by banks. In other words, to find out if the monetary base in Nigeria is endogenous or exogenously determined by the monetary authorities.

3.4.2 Granger-Sims Causality Test

The most popular statistical test for the direction of causality between a set of time series is the Granger-Sims test. According to Granger (1969) a series X_t Granger-causes

another series Y_t if taking account of past values of X_t leads to improved prediction for Y_t than not. In practice, this test requires estimating equations with autoregressive and distributed lagged components, similar to (3.10) and (3.11) below.

$$X_t = \sum_{j=1}^{m} f_j X_{t-j} + \sum_{i=0}^{n} g_i Y_{t-i} + \varepsilon_t \tag{3.10}$$

$$Y_t = \sum_{j=1}^{m} h_j Y_{t-j} + \sum_{i=0}^{n} k_i X_{t-i} + v_t \tag{3.11}$$

Testing the null hypothesis that Y_t does not Granger-cause X_t requires constructing an F-test for the joint significance of the $Y_i s$, or rather that the $g_i s$ are all equal to zero. The null hypothesis is rejected if test statistic F is found to be greater than the appropriate critical F. Similarly, testing the null that X_t does not Granger-cause Y_t requires constructing an F-test for the joint significance of the k_is. In other words, testing to see whether Y_t Granger-causes X_t requires running a regression of X_t on $X_{t-1}, \cdots, X_{t-m}$, $Y_{t-0}, \cdots, Y_{t-n}$ and testing the joint significance of the lagged Y_ts.

The first step in applying the Granger causality test is to ensure that each series employed in the regression is stationary. Combining series that are not stationary is likely to produce residuals that are not white noise. In such a case, the usual significance tests are not valid because parameter estimates from autocorrelated residuals are consistent, but the estimates of the variances of these parameters are biased downwards. This will lead to exaggerated F-statistics, and therefore, accepting a causal relationship which in fact does not exist, (Pierce and Haugh, 1977).

A non-stationary time series can be made stationary by differencing it a sufficient number of times (Granger and Newbold, 1977). The number of differencing required to achieve stationarity of a given series can be determined by using a test procedure known as the Augmented Dickey-Fuller (ADF)-test. [5] Assuming a time series (X_t), the ADF test requires estimating the following autoregressive process.

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[5] *This test is a large sample test. Results from a small sample should be interpreted with caution.*

$$\Delta X_t = a + bX_{t-1} + \sum_{i=1}^{p} \Delta X_{t-i} + e_t \qquad (3.12)$$

P is selected such that e_t is as close to white noise as possible. The null hypothesis being tested is that b=0 against the alternative that $b<0$. The null hypothesis is rejected if the t-value on the estimated $\hat{b}$ is larger than a critical t-value. The regular t-table is not appropriate in this case. An applicable t-table is provided in Fuller (1976). Rejecting the null at this stage means that the series X_t is stationary and therefore, does not require any differencing. In the terminology of time-series analysis, X_t is said to be integrated of order zero (I(0)). However, if the null hypothesis were accepted, it implies that X_t is not stationary in levels, but tentatively stationary in first differences. In other words, the series is not I(0), but tentatively I(1). To confirm that X_t is I(1), the ADF - test, equation (3.12) would have to repeated. This time, the second difference of X_t ($\Delta\Delta X_t$) is regressed on one period lagged first difference of X_t ($(\Delta X)_{t-1}$) and p lagged dependent variables. If the null hypothesis is rejected this time, then the series is confirmed as I(1) and need to be differenced once to achieve stationarity. Otherwise, the test procedure is repeated until the null is finally rejected. If the series X_t is found to be integrated of order n (I(n)), it would have to be differenced n-times to achieve stationarity.

One of the following set of outcomes will arise from applying the Granger-causality test:

i) A unidirectional causality running from Y_t to X_t. This arises when an F-test accepts the joint significance of the g_is in equation (3.10), but rejects those of the k_is in (3.11).

ii) A unidirectional causality running from X_t to Y_t. This occurs if an F-test rejects the joint significance of the g_is, but accepts those of the k_is.

iii) Feedback or bidirectional causality between X_t and Y_t exists if an F-test shows that the joint significance of both the g_is and the k_is cannot be rejected.

Results from the Granger-causality test should be interpreted with caution because

the test does not measure causality in the intuitive sense of the word. According to Maddala (1988), the Granger-causality test is simply a measure of whether Y_t precedes X_t, X_t precedes Y_t or they move together. The fact that one variable is found to precede (Granger-cause) another does not mean that the former causes the later.

The Sims causality test requires prefiltered logarithms of X_t to be regressed on the past, the present and future values of prefiltered logarithms of Y_t. If the coefficients of the future values of Y_t are found to be jointly equal to zero, causality is said to run from Y_t to X_t. According to Sims *"when (X, Y) has an autoregressive representation, X_t can be expressed as a distributed lagged function of current and past values of Y_t with residuals which are not correlated with any values of Y_t, past or future, if and only if, X_t does not cause Y_t in the Granger sense"* (Harvey 1990, p. 306)

3.4.3 Outcome of the Granger-Causality Test for Endogeneity of the Money Stock and the Monetary Base

In what follows, the Granger-approach is used to test for the following hypotheses using Nigerian data.[6]

(1) Monetary base Granger causes money stock (M1 and M2)

(2) Money stock (M1 and M2) Granger causes monetary base

(3) Domestic credit Granger causes money stock (M1 and M2)

(4) Money stock (M1 and M2) Granger cause domestic credit

For each of the cases above, the autoregressive part (regression of X_t on $X_{t-1}, \cdots, X_{t-n}$ or Y_t on $Y_{t-1}, \cdots, Y_{t-n}$ which are the restricted equations) is first estimated and parameterised so that the errors are white noise, before adding the lagged

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[6] *Hypotheses (3) and (4) test the Post-Keynesians' contention that the money which causes the monetary base is itself caused by the domestic credit.*

[6] *The Sims-test is not used in this study, firstly because of lack of degrees of freedom and secondly, since some of the observations are negative values, it is impossible to take the logarithms as required by the Sims methodology.*

distributed parts $(Y_{t-0}, \cdots, Y_{t-m})$ and $(X_{t-0}, \cdots, X_{t-n})$. It has been argued that unless m in equations (3.10) and (3.11) is chosen such that the error terms of the restricted equations are white noise, it is possible for the coefficients of the lagged Y_t in (3.10) and X_t in (3.11) to be inflated, leading to an acceptance of causality which in fact does not exist (Harvey 1990, p. 306). Furthermore, a set of dummy variables are used in each of the restricted equations to control for the shocks to the Nigerian economy discussed in chapter 2 (results excluding the dummies are also considered, see below).

Prior to estimating the restricted equations, a stationarity test is carried out using the (ADF) test briefly outlined earlier, with the intention of determining the number of times each variable should be differenced to achieve stationarity. All of the variables of interest (Monetary base, domestic credit, and the money stock) are found to be I(2). In other words, they need to be differenced twice before achieving stationarity. The necessary regressions are carried out using variables in second difference. When the level of the variables and the first difference were used, despite the presence of enough lagged dependent variables, the resultant regressions were found to be characterised by serially correlated error-terms.

The result of testing for proposition (1) above is presented in Table (3.1). All equations are free of both first and second order serial correlation, as shown by the relevant Lagrange multiplier tests. The normality test also shows that the error terms are normal. Columns 2 & 4 of the table are the restricted equations, while columns 3 & 5 are the unrestricted ones (the ones with the lagged distributed components). F^* gives the F-test for the validity of the restrictions that the coefficients of the lagged distributed components are jointly equal to zero. F(3, 13) - value of 0.78 indicates that the restriction between columns 2 & 3 of the table is valid. This means that the null hypothesis that the monetary base (H) does not Granger-cause the narrow money (M1) in Nigeria could not be rejected at 5 percent significance level. In Nigeria therefore, at least in the past, the monetary authorities did not use the monetary base to control the narrow

money (M1). The calculated F-value for the restriction between columns 5 & 6 of the table is 3.38. This seems to reject the null hypothesis that the combined effect of the lagged distributed component of the equation is equal to zero, at the 10 percent level. This implies that the monetary base does Granger cause the broad or quasi money (M2) in Nigeria.

The result of testing the hypothesis that money (M1 and M2) does not cause the monetary base is reported in Table (3.2). The restricted equation (column 2) and the unrestricted ones (columns 3 & 4) have errors that are free of both first and second order serial correlation, and non-normality, as required. The F-test for the validity of the restriction rejected the hypothesis that the lagged distributed components of the money stock are jointly equal to zero, (see table for calculated F-values).

The results of Tables (3.1) and (3.2) imply that in Nigeria there is a unidirectional causality running from the narrow money (M1) to the monetary base (H), while the relationship between monetary base and the broad money (M2) is that of feedback. In other words, M2 and the monetary base Granger-cause each other. Despite the differences in the structures of the economies of Nigeria and of the US, Moore (1988), arrived at a similar conclusion using US data.

The statistical evidence therefore, seems to suggest that the monetary base in Nigeria is Granger-caused by rather than being the cause of the money stock. At worst, the monetary base and the broad money (M2) Granger-cause each other.

The result of testing for causality between domestic credit and money are reported in Tables (3.3) and (3.4). In Table (3.3), the calculated F-value indicates that the null hypothesis that money (narrow and broad) does not Granger-cause domestic credit (DC) cannot be rejected even at the 10 percent level. However, the null hypothesis that domestic credit does not cause money is rejected at the 5 percent level in the case of Narrow money, and at the 10 percent level in the case of broad money (M2), (see Table (3.4)). In other words, in Nigeria, there is a unidirectional Granger-causality running

Table 3.1

Granger Causality Test - with Step Dummies (Monetary Base Causes Money)				
	(H causes M1)		(H causes M2)	
Const.	3131.44 (7.63)	2783.87 (3.11)	4404.13 (7.19)	3681.10 (4.17)
$(M1)_{t-1}$	-0.59 (-4.87)	-0.48 (-2.00)		
$(M1)_{t-2}$	-1.33 (-7.91)	-1.34 (-3.98)		
$(M1)_{t-3}$	-0.62 (-2.90)	-0.59 (-2.03)		
$(M1)_{t-4}$	-0.79 (-4.09)	-0.64 (-2.39)		
$(M2)_{t-1}$			-0.80 (-5.98)	-0.61 (-2.68)
$(M2)_{t-2}$			-1.49 (-9.11)	-1.77 (-6.26)
$(M2)_{t-3}$			-0.79 (-3.66)	-0.58 (-2.86)
$(M2)_{t-4}$			-0.77 (-3.88)	-0.57 (-2.86)
DUM 1973/74	-615.81 (-1.89)	-522.93 (-1.41)	-1044.37 (-2.30)	-873.72 (-2.17)
DUM 1981/82	1142.25 (3.22)	973.15 (2.11)	1230.60 (2.53)	940.03 (2.02)
DUM 1985/86	-3607.90 (-7.50)	-3191.05 (-3.10)	-4500.09 (-6.49)	-3672.60 (-3.70)
H		0.14 (0.38)		0.10 (0.29)
$(H)_{t-1}$		-0.09 (-0.17)		0.02 (0.04)
$(H)_{t-2}$		0.25 (0.58)		1.07 (1.98)
R^2	0.88	0.90	0.89	0.94
LM-Test 1^{st} Order Serial Corr.	F(1, 15) 0.01	F(1, 12) 1.11	F(1, 15) 0.57	F(1, 12) 4.17
LM-Test 2^{nd} Order Serial Corr.	F(2, 14) 1.49	F(2, 11) 2.17	F(2,14) 0.32	F(2, 11) 1.99
Normality $\chi^2(2)$	4.81	5.93	1.63	5.10
RSS	6104678.61	5176476.64	11875651.70	6673136.85
F*(3, 13)		0.78		3.38

Dependent Variables: M1(Narrow Money), M2(Broad Money)
t-Values are in parenthesis
F* :- Calculated F-value under the null of monetary base (H) does not cause money (M1 and M2).
Critical F(3, 13): 2.50(10%) 3.41(5%), 5.74(1%)
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 3.2

Granger Causality Test - with Step Dummies (Money Causes Monetary Base)		M1 cause H	M2 causes H
Const.	2338.84 (5.69)	1237.23 (3.87)	975.48 (2.08)
$(H)_{t-1}$	-0.71 (-4.65)	-0.78 (-5.14)	-0.91 (-4.19)
$(H)_{t-2}$	-0.44 (-2.09)	-1.04 (-4.51)	-1.50 (-3.90)
$(H)_{t-3}$	-0.20 (-0.86)	-1.46 (-5.88)	-1.73 (-4.06)
$(H)_{t-4}$	-0.16 (-0.86)	-0.36 (-3.20)	-0.16 (-1.14)
DUM 1979/80	-2142.00 (-3.50)	-1078.74 (-3.48)	-756.46 (-1.74)
DUM 1981/82	2559.14 (4.06)	1236.38 (3.85)	1139.62 (2.53)
DUM 1985/86	-2687.75 (-5.70)	-1440.70 (-3.96)	-1481.24 (-3.00)
M1		0.46 (4.24)	
$(M1)_{t-1}$		0.65 (6.94)	
$(M1)_{t-2}$		0.74 (3.32)	
$(M1)_{t-3}$		1.18 (5.87)	
M2			0.38 (3.10)
$(M2)_{t-1}$			0.64 (5.68)
$(M2)_{t-2}$			0.83 (3.06)
$(M2)_{t-3}$			1.18 (4.05)
R^2	0.77	0.97	0.94
LM-Test 1^{st} Order Serial Corr.	F(1, 15) 1.62	F(1, 11) 3.49	F(1, 11) 2.47
LM-Test 2^{nd} Order Serial Corr.	F(2, 14) 0.76	F(2, 10) 1.59	F(2, 10) 1.84
Normality $\chi^2(2)$	1.35	4.62	2.11
RSS	5104754.37	652271.16	1241554.22
F*(4, 12)		20.48	9.12

Dependent Variable: Monetary Base (H)
t-Values are in Parenthesis
F*:- Calculated F-Value under the null of Money (M1 and M2) do not cause Monetary Base (H)
Critical F(4, 12): 2.48(10%) 3.26(5%) 5.41(1%)
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 3.3

Granger Causality Test - with Step Dummies (Money Causes Domestic Credit)			
		M1 causes DC	M2 causes DC
Const.	-5712.40 (-2.71)	-4821.31 (-1.47)	-7443.54 (-2.27)
$(DC)_{t-1}$	-1.89 (-4.87)	-1.54 (-3.37)	-1.41 (-2.98)
$(DC)_{t-2}$	-0.35 (-0.75)	-0.52 (-1.09)	-0.58 (-1.29)
$(DC)_{t-3}$	-2.50 (-5.60)	-2.17 (-4.21)	-2.00 (-3.91)
$(DC)_{t-4}$	-1.92 (-3.26)	-1.83 (-2.88)	-1.83 (-2.92)
DUM 1973/74	-2399.04 (-1.77)	-2355.97 (-1.84)	-2217.41 (-1.74)
DUM 1985/86	8252.87 (3.50)	7303.94 (2.15)	9755.19 (2.98)
M1		0.077 (0.09)	
$(M1)_{t-1}$		-0.68 (-1.14)	
$(M1)_{t-2}$		-1.08 (-1.20)	
M2			0.72 (1.19)
$(M2)_{t-1}$			0.06 (0.13)
$(M2)_{t-2}$			-0.28 (-0.41)
R^2	0.84	0.88	0.88
LM-Test 1^{st} Order Serial Corr.	F(1, 16) 1.41	F(1, 13) 2.74	F(1, 13) 1.39
LM-Test 2^{nd} Order Serial Corr.	F(2, 15) 1.36	F(2, 12) 2.15	F(2, 12) 0.68
Normality $\chi^2(2)$	0.49	0.07	0.09
RSS	142594549.26	105300564.89	102782412.72
F*(3, 14)		1.65	0.181

Dependent Variable: Domestic Credit (DC)
t-Values are in Parenthesis
F*:- Calculated F-value under the null hypothesis that Money (M1 and M2) does not cause Domestic Credit (DC)
Critical F(3, 14): 2.52(10%) 3.34(5%) 5.56(1%)
Econometric Estimation Package: Hendry (9190) PC-Give Version 6.0.

Table 3.4

Granger Causality Test - with Step Dummies
(Domestic Credit Causes Money)

	DC causes M1		DC cause M2	
Const.	4100.32 (7.63)	2500.64 (6.56)	4404.13 (7.19)	4049.81 (6.46)
$(M1)_{t-1}$	-0.59 (-4.87)	-0.66 (-5.68)		
$(M1)_{t-2}$	-1.33 (-7.91)	-1.73 (-6.43)		
$(M1)_{t-3}$	-0.62 (-2.90)	-1.00 (-4.24)		
$(M1)_{t-4}$	-0.92 (-4.08)	-1.21 (-4.73)		
$(M2)_{t-1}$			-0.80 (-5.98)	-0.75 (-6.17)
$(M2)_{t-2}$			-1.49 (-9.11)	-1.46 (-5.62)
$(M2)_{t-3}$			-0.79 (-3.66)	0.92 (-3.86)
$(M2)_{t-4}$			-0.77 (-3.88)	-0.91 (-3.50)
DUM1973/74	-615.18 (-1.89)	-654.28 (-2.40)	-1044.37 (-2.30)	-990.60 (-2.50)
DUM 1981/82	1142.25 (3.22)	1265.14 (4.27)	1230.60 (2.53)	1277.76 (3.03)
DUM 1985/86	-3607.90 (-7.50)	-3045.71 (-6.55)	-4500.09 (-6.49)	-4241.68 (-5.86)
DC		0.012 (0.42)		0.009 (2.40)
$(DC)_{t-1}$		0.28 (2.36)		0.27 (1.57)
$(DC)_{t-2}$		0.18 (2.32		0.15 (1.30)
R^2	0.88	0.93	0.89	0.93
LM-Test 1^{st} Order Serial Corr.	F(1, 15) 0.01	F(1, 12) 4.89	F(1, 15) 0.57	F(1, 12) 4.51
LM-Test 2^{nd} Order Serial Corr.	F(2, 14) 1.49	F(2, 11) 3.09	F(2, 14) 0.32	F(2, 11) 3.41
Normality $\chi^2(2)$	4.81	31.52	1.63	19.27
RSS	6104678.61	3378067.91	11875651.70	7220962.48
F*(3, 13)		3.50		2.79

Dependent Variables: Narrow Money (M1) and Broad Money (M2).
t-values are in parenthesis.
F*:- Calculated F-value under the null hypothesis that Domestic Credit (DC) does not cause Money (M1 and M2)
Critical F(3, 13): 2.50(10%) 3.41(5%) 5.74(1%)
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

from domestic credit to money.

The above conclusions regarding the direction of Granger-causality between money stock/monetary base and the money stock/domestic credit rely on step dummy variables to capture some of the major shocks to the Nigerian economy (The Nigerian civil war, the first and second oil price shocks, the oil price collapse, and the 1985/86 economic liberalisation and the devaluation of the currency, see chapter 2 for full detail) were used.

The year the civil war began, the foreign assets of the Central Bank fell by about 50 percent, however, its domestic assets went up quite considerably as the Government borrowed from the Central Bank to finance the war. As a result, the monetary base declined only slightly. The end of the civil war saw an increase in the monetary base of nearly 100 percent as both foreign and the domestic components went up considerably.

The begining of the civil war did not affect the total domestic credit very drastically. Although borrowing by the Government went up, private credit fell as the economic activities, especially in the war affected areas declined. The end of the war, on the other hand, lead to about 50 percent increase in the domestic credit as private sector credit demand started picking up and the Government continued to expand borrowing to finance the reconstruction. The money stock also experienced a slight decline at the begining of the war, but the end of the war brought about a 30 percent increase in the narrowly defined money (M1).

Between 1973 and 1974, as a result of the increase in the oil price, there was a sudden increase in the monetary base by over 60 percent. This increase was mainly due to the increase in the foreign component, since the domestic component fell for the same period. The net foreign assets of the Central Bank went up by nearly 800 percent, while the net domestic assets fell by over 1000 percent as the Government retired its obligations to the Central Bank. Domestic credit in that period delined while the money stock M1 went up by about 90 percent. The effect of the oil price increase on the money stock was an indirect one. It mainly arose because of the huge increase in the country's

real income.

The second oil price increase of 1979 had a similar effect to the 1973/74 increases. The monetary base went up by about 100 percent, while the money stock went up by over 50 percent. The 1981/82 oil price collapse had a strong effect on the domestic credit; as the Federal Government again resorted to borrowing to finance its expenditures; in view of the decline in its revenue from oil. The monetary base and the money stock were only slightly affected because the negative effect of the decline in the foreign component of the monetary base was countered by an increase in the domestic component.

In 1986, as discussed in section 2.3.5 of chapter 2, Nigeria undertook to liberalise and restructure its economy. As a part of the programme it devalued the currency by about 60 percent. The end result of this was an increase in the net foreign assets of the Central Bank, denominated in local currency, by over 100 percent. The monetary base and the money stock also went up. The domestic credit on the other hand, rather than declining went up by about 20 percent. This was partly due to the increase in private demand for credit. The devaluation led to an increase in the local price of imported imputs, and with it an increase in the demand for credit to meet the increased working capital requirement.

Different sets of dummy variables appear in the different equations because the dummy variables that were found to be highly insignificant were dropped. For the purpose of making comparison, as in the last chapter, all the equations are re-estimated without any dummy variables and with impulse dummies. The result of testing the hypothesis that monetary base does not cause money stock (M1 and M2) when no dummies are used is presented in Table 3.1.1. The F-values 11.69 and 11.64 for M1 and M2 seem to suggest that the hypothesis would have to be rejected. However, Lagrange multiplier tests show that the errors of the equations are highly correlated, implying that the estimation results from these equations cannot be relied upon.

The result of testing the proposition that the money stock (M1 and M2) does not cause the monetary base are presented in Table 3.2.1. The proposition is very strongly rejected, implying that money does cause the monetary base. Lagrange multiplier tests in this case show that the hypothesis that the residuals from these equations are free of serial correlation can be accepted at the 10 percent level. The Granger-causality tests carried out without the step dummies, give no conclusive answer to the question of wether the monetary base Granger-causes the money stock or not, but the money stock is shown to very strongly Granger-cause the monetary base. Therefore, it can be cautiously said that even when no dummy variables are used, the monetary base is highly likely to be caused by the money stock, again implying that the monetary base is likely to be endogenous.

The result of testing the proposition that the money stock (M1 and M2) does not cause domestic credit is presented in Table 3.3.1. The equations have passed both first and second order serial correlation tests, and the test for the normality of the errors. This proposition is accepted both for narrow and broad money, implying that money does not Granger-cause domestic credit. The result of testing the proposition that domestic credit does not Granger-cause money stock (M1 and M2) is presented in Table 3.4.1. F- tests show that the proposition is rejected for M1 but accepted for M2. In fact, the equation for broad money (M2) seems to suffer from a high level of second order serial correlation, placing in doubt any results given by that equation. When looked at in conjunction with the result of Table 3.3.1, the conclusion that can be drawn is that there is a clear one way Granger causality running from domestic credit to narrow money (M1) but not broad money (M2).

The results from estimating the equations with impulse dummies are similar to those without the dummy variables. All the impulse dummies were very insignificant (results not reported here).

Table 3.1.1

Granger Causality Test with no Dummies (Monetary Base Causes Money)				
	(H causes M1)		(H causes M2)	
Const.	356.62 (1.36)	62.88 (0.38)	629.20 (1.81)	332.77 (1.51)
$(M1)_{t-1}$	-0.21 (-0.96)	-0.77 (-2.88)		
$(M1)_{t-2}$	-1.10 (-3.34)	-0.81 (-2.35)		
$(M1)_{t-3}$	-0.34 (-0.83)	-0.23 (-0.82)		
$(M1)_{t-4}$	-0.57 (-1.51)	-0.14 (-0.56)		
$(M2)_{t-1}$			-0.35 (-1.65)	-0.88 (-3.01)
$(M2)_{t-2}$			-1.21 (-4.22)	-1.56 (-4.19)
$(M2)_{t-3}$			-0.49 (-1.28)	-0.32 (-1.25)
$(M2)_{t-4}$			-0.59 (-1.64)	-0.21 (-0.89)
DUM 1973/74				
DUM 1981/82				
DUM 1985/86				
H		1.12 (4.87)		1.20 (3.89)
$(H)_{t-1}$		-0.95 (-2.13)		1.29 (2.05)
$(H)_{t-2}$		0.58 (1.21)		1.68 (2.45)
R^2	0.44	0.83	0.54	0.86
LM-Test 1^{st} Order Serial Corr.	F(1, 18) 4.03	F(1, 15) 9.82	F(1, 18) 3.34	F(1, 15) 8.51
LM-Test 2^{nd} Order Serial Corr.	F(2, 17) 10.99	F(2, 14) 4.66	F(2,17) 8.29	F(2, 14) 15.39
Normality $\chi^2(2)$	2.16	4.31	4.81	0.61
RSS	28807535	9027282	47212165	14826865
F*(3, 16)		11.69		11.64

Dependent Variables: M1(Narrow Money), M2(Broad Money)
t-Values are in parenthesis
F* :- Calculated F-value under the null of monetary base (H) does not cause money (M1 and M2).
Critical F(3, 16): 3.24(5%), 5.29(1%)
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 3.2.1

Granger Causality Test - with no Dummies (Money Causes Monetary Base)			
		M1 cause H	M2 causes H
Const.	230.12 (1.06)	-30.71 (0.35)	-265.24 (-2.34)
$(H)_{t-1}$	-0.23 (-1.00)	-0.51 (-2.22)	-0.67 (-2.62)
$(H)_{t-2}$	-0.12 (-0.36)	-0.94 (-2.52)	-1.64 (-3.49)
$(H)_{t-3}$	-0.06 (-0.14)	-1.53 (-3.78)	-1.90 (-3.89)
$(H)_{t-4}$	-0.16 (-0.47)	-0.29 (-1.93)	-0.02 (-0.14)
DUM 1979/80			
DUM 1981/82			
DUM 1985/86			
M1		0.75 (6.95)	
$(M1)_{t-1}$		0.76 (5.04)	
$(M1)_{t-2}$		0.95 (3.05)	
$(M1)_{t-3}$		1.36 (4.20)	
M2			0.65 (6.51)
$(M2)_{t-1}$			0.80 (6.52)
$(M2)_{t-2}$			1.17 (4.03)
$(M2)_{t-3}$			1.46 (4.43)
R^2	0.09	0.89	0.89
LM-Test 1^{st} Order Serial Corr.	F(1, 18) 0.00	F(1, 14) 5.50	F(1, 14) 0.00
LM-Test 2^{nd} Order Serial Corr.	F(2, 17) 0.01	F(2, 13) 5.68	F(2, 13) 6.52
Normality $\chi^2(2)$	5.44	0.24	0.82
RSS	19987999	2215881	2477544
F*(4, 15)		30.07	26.50

Dependent Variable: Monetary Base (H)
t-Values are in Parenthesis
F*:- Calculated F-Value under the null of Money (M1 and M2) do not cause Monetary Base (H)
Critical F(4, 15): 3.68(5%) 6.36(1%)
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 3.3.1

Granger Causality Test - with no Dummies (Money Causes Domestic Credit)			
		M1 causes DC	M2 causes DC
Const.	746.78 (0.94)	1232.52 (1.72)	1171.83 (1.46)
$(DC)_{t-1}$	-2.35 (-1.62)	-1.80 (-3.79)	-1.92 (-3.70)
$(DC)_{t-2}$	-0.22 (-0.39)	-0.21 (-0.40)	-0.35 (-0.64)
$(DC)_{t-3}$	-1.99 (-3.75)	-2.02 (-3.47)	-1.81 (-2.86)
$(DC)_{t-4}$	-1.21 (-1.74)	-1.37 (-1.98)	-1.37 (-1.80)
DUM 1973/74			
DUM 1985/86			
M1		-1.02 (-1.49)	
$(M1)_{t-1}$		-1.30 (-2.37)	
$(M1)_{t-2}$		-1.87 (-2.05)	
M2			-0.26 (-0.45)
$(M2)_{t-1}$			-0.82 (-1.75)
$(M2)_{t-2}$			-1.17 (-1.48)
R^2	0.71	0.82	0.79
LM-Test 1^{st} Order Serial Corr.	F(1, 18) 2.89	F(1, 15) 0.22	F(1, 15) 0.03
LM-Test 2^{nd} Order Serial Corr.	F(2, 17) 1.78	F(2, 14) 0.97	F(2, 14) 1.50
Normality $\chi^2(2)$	1.24	1.87	1.62
RSS	250748545	156000087	183069225
F*(3, 16)		3.23	1.97

Dependent Variable: Domestic Credit (DC)
t-Values are in Parenthesis
F*:- Calculated F-value under the null hypothesis that Money (M1 and M2) does not cause Domestic Credit (DC)
Critical F(3, 16): 3.24(5%) 5.29(1%)
Econometric Estimation Package: Hendry (9190) PC-Give Version 6.0.

Table 3.4.1

Granger Causality Test - with no Dummies (Domestic Credit Causes Money)				
	DC causes M1		DC cause M2	
Const.	356.62 (1.36)	282.17 (1.28)	629.20 (1.81)	612.23 (1.99)
$(M1)_{t-1}$	-0.21 (-0.96)	-0.55 (-2.38)		
$(M1)_{t-2}$	-1.10 (-3.34)	-2.16 (-4.49)		
$(M1)_{t-3}$	-0.34 (-0.84)	-1.19 (-2.75)		
$(M1)_{t-4}$	-0.57 (-1.51)	-1.54 (-3.40)		
$(M2)_{t-1}$			-0.35 (-1.65)	-0.49 (-2.33)
$(M2)_{t-2}$			-1.21 (-4.22)	-1.90 (-4.35)
$(M2)_{t-3}$			-0.49 (-1.28)	1.14 (-2.75)
$(M2)_{t-4}$			-0.59 (-1.64)	-1.36 (-3.13)
DUM1973/74				
DUM 1981/82				
DUM 1985/86				
DC		-0.005 (-0.10)		0.08 (1.11)
$(DC)_{t-1}$		0.57 (2.90)		0.76 (2.87)
$(DC)_{t-2}$		0.21 (1.39)		0.19 (0.88)
R^2	0.44	0.68	0.54	0.71
LM-Test 1^{st} Order Serial Corr.	F(1, 18) 4.03	F(1, 15) 5.90	F(1, 18) 3.34	F(1, 15) 2.19
LM-Test 2^{nd} Order Serial Corr.	F(2, 17) 10.99	F(2, 14) 2.86	F(2, 17) 8.29	F(2, 14) 1.78
Normality $\chi^2(2)$	2.16	1.46	4.81	2.11
RSS	28807535	16824745	47212165	30101754
F*(3, 16)		3.80		3.03

Dependent Variables: Narrow Money (M1) and Broad Money (M2).
t-values are in parenthesis.
F*:- Calculated F-value under the null hypothesis that Domestic Credit (DC) does not cause Money (M1 and M2)
Critical F(3, 16): 3.24(5%) 5.29(1%)
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

The findings of this empirical analysis that the monetary base in Nigeria is being Granger-caused by rather than causing money may mean one or both of the following: 1) the monetary base can be changed by the Central Bank of Nigeria, but in practice the central bank did not in the past use it for monetary policy purposes. 2) the Central Bank behaves in the manner suggested by the Post-Keynesians; supplying reserves to the commercial banks as often as required, and when necessary using interest rates (discount rate) to effect changes in the money market.

Observation of the actual behaviour of the Central Bank of Nigeria discussed in earlier chapters reveals elements of both possibilities. The Central bank has the power to buy and sell government securities for monetary policy purposes (change the monetary base), although it has never done so in the past. Its holdings of government securities went up as and when desired by the Federal Government for the purposes of deficit financing. This indicates some elements of the first point. The fact that the Central Bank of Nigeria has in its portfolio of assets, loans and discounts it extends to the commercial banks and other institutions, probably to supply them with reserves, plus the fact that it has, as discussed in section (2.7), used the discount rate quite extensively since 1962 tends to support scenario number (2) above more so than number (1). Another possible explanation for the Granger-causality test showing that the monetary base is likely to be endogenous than not may be the fact that the Nigerian exchange rate has been basically fixed for the major part of the period covered by this study. A detailed analysis of this point is taken up in chapters 5 and 6.

The above findings seem to suggest that the monetary base and the money stock in Nigeria are likely to be endogenously demand determined. The only source of influence the Central bank of Nigeria may have on the money stock is through the factors that determine the money demand, for example, interest rates. The degree to which it succeeds in attaining the desired money stock, using the determinants of the money demand, depends on the elasticities of these determinants with respect to the money

demand, and the stability of the money demand function itself. This issue is taken up in detail in chapter 4.

3.5 Summary and Conclusions

The money supply equation often seen in the standard economic textbooks is derived in the context of the monetary base/money multiplier approach to money stock determination. According to this equation, the money stock is always identically equal to the product of the money multiplier and the monetary base. This theory assumes that the money multiplier is stable and central banks can change the money stock in the desired direction, by changing the monetary base, which is completely under their control.

The money multiplier approach as a theory of money supply determination has many deficiencies. To start with, the equation underlying this theory is derived from two identities and therefore, itself an identity. As an indentity, it lacks the necessary behavioural content to be a credible theory of money supply determination. As a result, the role played by banks and the non-bank public in the money supply process is undermined. An alternative specification which corrects this particular problem of the money multiplier approach is a general equilibrium model that takes explicit account of portfolio adjustments by banks and the non-bank public. The successful implementation of an elaborate model of this nature requires a relatively developed financial system, unlike that which obtains in a developing country like Nigeria.

Secondly, it is wrong to take the monetary base as exogenously given as the money multiplier approach does. Instead, domestic and foreign factors that bring about changes in this variable should be closely investigated.

The money multiplier analysis assumes that the monetary base is exogenous and can be changed at will, and therefore, it follows that the money stock is also exogenous and can be changed by the central bank as well. In reality, this conclusion may only be true for a commodity or fiat money economy where the money supply function is

independent. In a credit money economy, which describes most modern economies, including that of the developing countries, the monetary base and the money stock are both likely to be endogenously determined by the demand for money. These variables only change when conditions determining the demand for money change. The banks, including the central bank, play a passive accommodating role of supplying the amount of money demanded. When there is an increase in credit demand, commercial banks will automatically supply it. Since the proceeds of the loans are eventually deposited with the commercial banks, there will be an increase in the total deposits and thus the money stock. In most modern economies, a certain percentage of any increase in deposits would have to be held as reserves. Bank reserves are a component of the monetary base, so any change will be directly reflected on the monetary base. Therefore, contrary to the basic assumption of the money multiplier approach, changes in the money stock, presumably brought about by changes in demand for it, causes changes in the monetary base.

An empirical test of this hypothesis, which is proposed by a group of economists known as the Post-Keynesians, requires testing for a causal relationship between domestic credit and the money stock on the one hand, and between the money stock and the monetary base on the other. Causation running from domestic credit to money and from money to monetary base supports the position of the Post-Keynesians.

Applying the Granger-Sims causality test to the Nigerian data showed a uni-directional causality running from narrow money (M1) to the monetary base, but a feedback between the broader money (M2) and the monetary base when the equations are specified to include a set of step dummies catering for some of the major shocks to the Nigerian economy. Without the step dummies the results show that the hypothesis that the money stock does not cause monetary base can be strongly rejected, but no conclusive statement can be made regarding whether monetary base causes money stock or not. A similar result is also found for the money-domestic credit causality test. The Granger-causality test utilised to arrive at the above conclusion has been criticised as

simply a measure of which variable precedes another temporally, rather than that of causality in the every day sense of the word.

The weaknesses of the Granger-causality test notwithstanding, the result of the test seems to imply that the monetary base in Nigeria is endogenously determined by credit/money demand. The Central Bank of Nigeria cannot therefore use it to change the money stock for monetary policy purposes. The only possible channel of influence on the money stock, besides direct credit control, is through the money demand, via one of the determinants - interest rates. How successful the Central Bank is in changing the money stock in this manner depends a great deal on the stability and the interest elasticity of the money demand. The issue of the stability of the Nigerian money demand function is taken up in the next chapter.

Chapter 4

Stability of the Money Demand Function in Nigeria

4.1 Introduction

In the last chapter it was shown that the monetary base and the money stock in Nigeria are likely to be endogenous and demand determined. This implies that changing the money stock for monetary policy purposes can only be achieved through changing the demand for it. A successful conduct of monetary policy in this case will require a stable money demand function, which is significantly linked with the control variable (the interest rate).

In this chapter, the stability of the Nigerian money demand function is examined by estimating three different specifications of the money demand function; namely, the standard partial adjustment specification, a specification with variables in levels and changes, and one in the form of error-correction and cointegration. There are two main objectives to this exercise. Firstly, it will allow a statement to be made regarding the abilities of the Nigerian Monetary Authorities to control the money stock. Secondly, it will provide a necessary background study to the next two chapters which investigate, using the monetary approach to the balance of payments theory, the degree to which the domestic component of the monetary base is offset by the foreign component.

The outline of the rest of the chapter is as follows: In section 4.2, the theory of money demand is reviewed. Section 4.3 discusses the partial adjustment specification of the short-run demand for money, while section 4.4 takes up the critique of this method of specifying the short-run money demand function. A discussion of the alternative dynamic specifications of the short-run demand for money is carried out in section 4.5. Section 4.6 takes up the issue of identification and simultaneity in relation to estimating

the money demand function. The result of estimating the different money demand functions and their discussions are presented in section 4.7. Finally, the summary and conclusion to the chapter is presented in section 4.8.

4.2 The Theory of Money Demand

It is almost universally accepted that the demand for real money balances should be specified as a function of a scale variable and an opportunity cost variable. The money demand function is often defined in terms of a constant elasticity function, represented by equation (4.1) below.

$$\frac{M^*}{P} = b_0 Y^{b_1} I^{b_2} \tag{4.1}$$

$$m^* = b_0 + b_1 y + b_2 i \tag{4.2}$$

Where $\frac{M^*}{P}$ is the real quantity of money demanded, Y is some scale variable, and I is the opportunity cost of holding money. Using lower case letters to represent the logarithm of a variable, equation (4.1) can be linearised to give equation (4.2). The parameters (b_1) and (b_2) are the long-run elasticities of money demand with respect to the scale variable and the opportunity cost variable respectively. The quantity of real money $\left[\frac{M^*}{P}\right]$ can be narrow money (currency plus demand deposits - M1) or broad money (M1 plus savings/time deposits - M2). What constitutes an appropriate definition for the scale variable differs between the two main schools of thought.

According to the Keynesian school,[1] there are three main motives for holding money, namely, the transactions motive, precautionary motive, and the speculative motive. The transactions motive arises from the desire by agents to hold some money to make regular planned purchases of goods and services (for example weekly grocery shopping). The precautionary motive arises because of the desire by agents to hold some

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[1] *The discussion that follows is mainly due to Keynes (1936)*

money for unplanned expenditures, as a result of an emergency or some similar circumstances. Both the precautionary and the transactions demand for money are positively related to the current real income. In fact, these two motives are often combined and referred to as the transactions motive.

It is generally assumed that, in addition to money, agents hold their wealth in the form of other assets that carry a promise to pay the holder a certain income per annum, fixed in money terms. These assets are collectively referred to as bonds in the literature. There is an inverse relationship between the interest rate and the price of bonds. When the interest rate goes up, the price of bonds come down. This means that the value of bonds held is going to decline and those who held their wealth in bonds will experience a capital loss. The converse will be the case when the interest rate falls.

One of the characteristics of money, which bonds do not possess, is that its value does not change with a change in the interest rate. Therefore, when the interest rate is expected to go up, which usually happens when the interest rate is below a certain perceived normal level, the agents will go out of bonds and go into money to avoid the pending capital loss. When the interest rate is higher than the perceived normal level, wealth holders will expect it to fall, and they will buy more bonds and in the process reduce the amount of money they hold. The demand for money for the purpose of trying to avoid a capital loss is the speculative demand for money. It increases when the interest rate is low and decreases when the interest rate is high. The wealth variable is important in that it determines the total amount of bonds held, and therefore, indirectly the speculative demand for money. However, since wealth does not change in the short-run, the speculative demand for money can be defined as a function of the interest rate only. The total money demand (speculative and transactions), according to the Keynesian analysis, is determined by the current real income and the interest rate only. The appropriate scale variable is the real current income.

The monetarist school epitomised by Friedman (1956) holds the view that the

demand for money should be analysed in the same manner as the demand for any other durable goods. According to consumer theory, the demand for any good is a function of a constraint variable, normally some kind of income, own price, the price of other goods, and tastes and preferences. The individual consumer purchases more than one type of good at any given point in time. The maximum he can purchase of any good is constrained by his total income. When his income goes up he buys more of all goods as long as they are normal goods. Similarly, money is not the only asset an agent can hold. Other interest earning financial assets like bonds or real assets like property, equities, etc. are also held. All the assets held would have to add up to the agent's total wealth. The maximum amount of money that can be held, or any of the other assets in the portfolio, must be less than or equal to the total wealth. An agent's total wealth defines the constrained on money holding like income defines the constrained on the purchases of a given good and services. This implies that the appropriate scale variable in the money demand function should be the total wealth and not the current real income as suggested by the Keynesian analysis.

Others[2] have argued that the appropriate scale variable should be a measure of consumer expenditure. According to the Keynesian analysis of the demand for money, briefly outlined above, the transactions component of the money demand should depend on the real income (GNP or GDP). *While all components of GNP generate transactions, consumers' transactions generates the most money demand. Federal Government transactions generate less money demand because the federal Government accounts are not included in measured M1 or M2. Business transactions generate less money demand because businesses are more sophisticated at financial management than households,* (Mankiw and Summers, 1986 p. 416). The best scale variable to explain the transactions demand for money should therefore, be consumer expenditures. Also, if it is accepted that the appropriate scale variable is permanent income, the best proxy for it should be

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[2] *see for example Mankiw and Summers, (1986)*

consumption, since it is postulated to be proportional to permanent income. Irrespective of whether the transactions or the portfolio theory of money demand is being looked at, the appropriate scale variable, according to the above argument should be the consumers' expenditure.

The opportunity cost of holding money can be defined in terms of the services the other assets render to the holder. Interest earning assets, for example, provide the holder with income (interest income and capital gains/losses). Although different assets have different rates of return, because of the ease with which one asset can be substituted for the other, it is believed that these rates of return generally move together, so one representative rate of return can be used in the demand for money analysis. The other component of the income provided by the interest earning assets is the capital gain/loss that arises with any change in the interest rate. This variable is proxied by the percentage rate of change of the interest rate. Since expected increases in the interest rate lead to a capital loss, this variable, according to the monetarists, should enter the money demand function with a negative sign, or preferably it should be deducted from the interest earnings.

The services money provides are in real terms, so the demand for money is the demand for real balances.[3] Changes in the price level affect the real value of the money held. An increase in the price level reduces the value of the services money renders, and thus reduces its rate of return. The opposite holds if prices go down. The percentage rate of change of the price level should enter the money demand function to represent own rate of return on money holding. According to the monetarist specification of the money demand, the total wealth, the nominal interest rate, the rate of change of the interest rate and the rate of change of the price level should enter the money demand function.

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[3] *This proposition can in fact be tested through estimating the demand for nominal rather than real money, where the price level appears as one of the explanatory variables. An estimated coefficient value of unity on the price variable confirms the proposition. However, for the purpose of deriving the monetarists specification of the money demand function, it is sufficient to assume that the proposition holds.*

The variable (I or i) in the long-run money demand function represents the opportunity cost of holding money. The purpose of holding money includes its use as a medium of exchange for goods and services, and its use as a means of storing value (wealth). Money alone, among all assets, can perform the function of a medium of exchange for goods and services, but there are other assets that can be used for the store of value purpose. Both schools of thought agree that, in addition to money, wealth can be held in the form of other financial assets (bonds, etc.) and non-financial assets like equities, houses, gold, etc. The opportunity cost of holding money arises because there are returns to holding wealth in a spectrum of other assets which cannot be realised by holding money. In the developed countries where there are a variety of financial assets available to a wealth holder (some closer to money than others), the degree of substitution between money and the non-financial assets are assumed to be negligible. The opportunity cost of holding money is defined in terms of the rate of return on the financial assets only, (one or more interest rates).

The situation in the developing countries is slightly different. Unlike the developed countries, there are few alternative domestic and foreign financial assets available to a wealth holder. This is partly due to the paucity of the domestic financial markets and partly due to the presence of capital control measures. Moreover, the observable interest rates do not, in general reflect money market conditions, because in most cases they are institutionally pegged. The following quote from Fry (1988) explains the developing countries' financial markets

> *"....in most developing countries, neither corporate nor government bonds are traded in the open markets. Indeed, corporate bonds simply do not exist in many developing countries. Typically, the commercial banks are captive buyers of low yielding domestic government bonds by virtue of liquidity ratio requirements"*

The asset choice of most wealth holders in the developing countries is limited to money or physical assets (land, houses, consumer durables, etc.) This means that money holdings in these countries will be sensitive to the yields on real and not financial assets.

In the literature, this is approximated by the rate of depreciation in the real value of money (rate of change of the general price level or the inflation rate).[4] When the inflation rate is expected to go up and thus depreciate the value of money held, agents will substitute away from money and in the process reduce their demand for money. Since money as an asset has desired qualities which real assets do not possess (liquidity), an expected decline in the inflation rate will lead to an increase in the demand for it.

4.3 Partial Adjustment and the Short-run Money Demand Function

The money demand equations (4.1) and (4.2) represent the long-run equilibrium quantity of money demanded.[5] In the real world, the actual quantity of money held often differs from the desired or the long-run quantity. An agent may not be able to return to his equilibrium level of money holding within a given period (e.g one quarter or one year) after a disturbance. One likely reason for such an inertia is that adjusting a portfolio to eliminate the disequilibrium may be costly. However, it is also costly for the agent to maintain the disequilibrium. These two costs are usually presented as quadratic loss functions in the form of equations (4.3) and (4.4) below.

$$C_1 = \alpha (m_t^* - m_t)^2 \tag{4.3}$$

$$C_2 = \beta (m_t - m_{t-1})^2 \tag{4.4}$$

$$TC = \alpha(m_t^* - m_t)^2 + \beta(m_t - m_{t-1})^2 \tag{4.5}$$

$$m_t = m_{t-1} + \gamma(m_t^* - m_{t-1}) \quad where \quad \gamma = \alpha/(\alpha + \beta) \tag{4.6}$$

$$m_t = \gamma b_0 + \gamma b_1 y + \gamma b_2 i + (1 - \gamma) m_{t-1} \tag{4.7}$$

The cost of being away from the desired or target money holdings is represented by equation (4.3). It is assumed to depend upon the gap between an agent's desired money holding (m_t^*) and the amount he actually holds (m_t). If the amount he currently holds is greater than the desired, he suffers the cost of foregone interest income, income which would have been earned if the excess money were in an interest earning asset. If the current amount of money held is below the desired level, he suffers risks and

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[4] *See for example, Adekunle (1967), Wong (1977), and Darrat (1985).*

[5] *This quantity is some times referred to as the desired or the target quantity.*

inconveniences. For example, if the agent's cash balances fall short of what is required for a certain transaction, he either has to postpone the transaction until later or undertake it on credit and incur an explicit interest cost.

The cost of portfolio adjustment is represented by equation (4.4). In moving towards the desired money holding, agents must increase or decrease the actual amount of money they hold. This can only be achieved through sales or purchases of other assets in their portfolios. These transactions entail brokerage cost. Even if an agent were not faced with an explicit brokerage fee, the time spent carrying out the transaction, which could have been utilised elsewhere more productively, constitutes a cost.

As the agent moves to eliminate the disequilibrium, the cost of being out of equilibrium decreases but the cost of his portfolio adjustment increases. The agent's problem is therefore, to choose that amount of money which minimises the total cost (the sum of the two costs), represented by equation (4.5). Differentiating (4.5) with respect to (m_t), setting the result equal to zero and rearranging gives equation (4.6). According to this equation, agents adjust the discrepancy between their desired and actual money holding slowly. The parameter (γ) is the adjustment coefficient. Its value is usually postulated to be between zero and one. When (γ) takes on the value of one (possible only when $\beta = 0$ and therefore, there is no cost to adjusting portfolios) the actual money balances will always be equal to the desired money balances, implying that adjustment is instantaneous. If (γ) takes on a value of zero (possible only when $\alpha = 0$ and therefore, there is no cost to being out of equilibrium) the actual money holding will be equal to last period's money holding. This implies that agents will never bother adjusting their money holding towards the equilibrium level. Generally, the closer the adjustment coefficient to one, the faster will the agent adjust his money holding towards the desired level.

Substituting the long-run money demand function (4.2) into (4.6) and collecting like terms gives equation (4.7). This equation is the standard short-run demand for money function, almost universally estimated before the advent of the instability problem of the

early 1970s.[6] Here a one period lagged dependent variable appears in the equation to cater for the dynamics of the system. The long-run coefficient of the money demand function can be recovered through dividing the short-run coefficients by the adjustment coefficient (one minus the coefficient of the lagged dependent variable).

4.4 Critique of the Partial Adjustment Specification of the Short-run Money Demand Function

One of the main problems with the standard formulation of the short-run demand for money function (equation 4.7), is that of the dynamics of adjusting from actual to an equilibrium level of money holding. As discussed earlier, the likelihood that an agent may not be able to adjust to his desired or target money balances is handled by the inclusion of a one period lagged dependent variable into the equation. This formulation implies that the cost of adjusting money holdings is the same whether the initial disturbance is due to a change in the real income or interest rate. The following scenario outlined by Gordon (1984) suggests that adjustment costs are not only different for changes in real income and interest rates, but also depend on either an increase or decrease in the determinants that lead to the disruption of the initial equilibrium. Furthermore, even the degree to which these changes are anticipated may make some differences to the cost of adjustment.

If there is an increase in income, paid either by cash or cheque, there will be no cost to the agent in increasing his real money holding, since these assets are money. The only relevant portfolio adjustment cost will be in trying to decrease the quantity of money held by reallocating it to other forms of assets. This portfolio adjustment cost will depend on whether the income increase is anticipated or not. If the increase were anticipated, the amount of money held can be temporarily lowered below the desired level just before receiving the payment and thereby, reducing any excess to be transformed into other

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[6] *see Judd and Scadding (1982), and Laidler (1980) for a survey.*

assets, and thus reducing the cost of portfolio adjustment.

The situation is slightly different when there is a change in the interest rate. To begin with, a change in a market determined interest rate is seldom anticipated. Real money balances adjust slowly to changes in the interest rate because of the delay in adjusting expectations of the interest rate level and the adjustment costs. *"Thus at the individual level gradual adjustment of real balances makes sense for interest rates but not for real income"*, (Gordon, 1984 p. 411).

The imposition of a single adjustment parameter across all the independent variables can lead to a dynamic misspecification. Relevant lagged values of the independent variables could be wrongly excluded from the equation, thus leading to an erroneous conclusion that the speeds of adjustment are slow when in fact they are not. Furthermore, such a misspecification could lead to serially correlated error terms and biased estimates of the parameters. This problem may be responsible for estimates of this type of equation almost universally rendering serially correlated error terms and where the Cochrane-Ocutt correction procedure is almost uniformly used, (see for example Goldfeld 1973, 1976, etc.).

4.4.1 Wealth as a Scale Variable

The non-instantaneous adjustment of money balances is not the sole explanation for the existence of a lagged dependent variable in the money demand function. In fact, using wealth rather than current real income as the scale variable can lead to a similar equation to (4.7) above. In empirical studies, wealth is usually proxied by permanent income, defined as the discounted present values of expected future income (Laidler, 1985). If a constant discount rate is assumed, permanent income can be represented by expected income.

Supporters of the hypothesis that wealth is the appropriate scale variable, use adaptive expectations or the error learning process to approximate expected income.

According to this procedure, in each period, agents revise their expectation in proportion to the difference between what they expect their income to be and what it actually turned out to be. This expectation formation process can be written as equation (4.8) below.

$$y_t^e = y_{t-1}^e + \lambda(y_t - y_{t-1}^e) \tag{4.8}$$

$$y_t^e = \lambda y_t + (1-\lambda)y_{t-1}^e \tag{4.9}$$

$$m_t = \lambda b_0 + \lambda b_1 y_t + b_2 r - (1-\lambda)b_2 r_{t-1} + (1-\lambda)m_{t-1} \tag{4.10}$$

Where y_t^e stands for what the agents expect their income to be in the next period, y_{t-1}^e for the last period's expectation about the income this period, and y_t his actual income this period. The variable λ is the coefficient of expectations, whose value is postulated to be between zero and one ($0 < \lambda < 1$). If λ takes the value of one it means that agents have perfect foresight, and their expected income is exactly equal to their actual income ($y_t^e = y_t$). On the other hand, if $\lambda = 0$, it implies that agents do not revise their expectations at all, and therefore, their expected income this period and last period is the same ($y_t^e = y_{t-1}^e$). In this case, the agents are said to have a static expectation. Rearranging equation (4.8) gives (4.9). Substituting equation (4.9) into the monetarists' specification of the money demand (equation 4.2 where the scale variable y is replaced by expected or permanent income) and using Koyck's transformation renders equation (4.10). This equation is slightly different from (4.7), in that, in addition to the other explanatory variables, one period lagged opportunity cost of holding money appears. Furthermore, equation (4.10) is a specification of the equilibrium or long-run money demand. It is possible to introduce the partial adjustment assumption to this specification. The final equation in this case, would contain one and two periods lagged dependent variables, (see for example, Laidler & Parkin, 1970, and Coghlan, 1978).

Despite the differences between equations (4.7) and (4.10), the two equations are sufficiently similar *"that if (4.10) was in fact the true model of the demand for money function, then anyone who fitted (4.7) would obtain rather good results and vice versa"*, (Laidler, 1985 p. 108).

4.5 Alternative Dynamic Specification

In the last couple of sections it was pointed out that the short-run money demand specification (equation 4.7) is inadequate because an identical adjustment rate is assumed for all types of shocks and over all periods. As a result only one lagged variable (the lagged dependent variable) appears in the equation. One way of getting around this short-coming is to specify the function in the form of a general autoregressive distributed lagged (ADL) model discussed in section (2.5) of chapter 2 (see also Hendry and Mizon 1978). When applied to the money demand function, it can be written as equation (4.11) below:

$$m_t = a + \sum_{j=0}^{n} b_j y_{t-j} + \sum_{j=0}^{n} c_j i_{t-j} + \sum_{j=1}^{n} d_j m_{t-j} + \varepsilon_t \tag{4.11}$$

$$m_t = a + b_0 y_t + b_1 y_{t-1} + c_0 i_t + c_1 i_{t-1} + d_1 m_{t-1} + \varepsilon_t \tag{4.12}$$

$$\Delta m_t = a + b_0 \Delta y_t + c_0 \Delta i_t + (b_0 + b_1) y_{t-1} + (c_0 + c_1) i_{t-1} + (d_1 - 1) m_{t-1} + \varepsilon_t \tag{4.13}$$

$$\Delta m_t = a + b_0 \Delta y_t + c_0 \Delta i_t + (d_1 - 1)\left[m_{t-1} - \left(\frac{b_0 + b_1}{1 - d_1} \right) y_{t-1} \right] + (c_0 + c_1) i_{t-1} + \varepsilon_t \tag{4.14}$$

Assuming (n = 1), equation (4.11) can be simplified and written as (4.12). Unlike (4.7), in addition to the lagged dependent variable, lagged values of each independent variable appear in this equation. Although an improvement over equation (4.7), equations (4.11) and (4.12) are not entirely satisfactory. The equilibrium condition embodied in them is a static one, (Harvey, 1990). This implies that there is only one equilibrium point which the system gets back to after any disturbance. In other words, there is no growth in the system, enabling the equilibrium point to change overtime. The equilibrium concept relevant to most economic variables is however, that of the steady state. A steady state relationship between variables is said to exist if, despite a growth in each variable, a certain specific long-run relationship is maintained.

After adding and subtracting variables, and collecting like terms, (4.12) can be

written as (4.13). This equation, by specifying the variables in levels and changes, introduces some growth elements to the system and moves away from the restrictive assumption of static equilibrium embodied in (4.12).[7] In addition, (4.13) has the following advantages: 1) As discussed in section (2.5) of chapter 2, specifying the equation in levels and changes is likely to reduce the multicollinearity problem inherent in equations specified in the form of (4.12). 2) It allows for a clean separation between the long-run and the short-run effects in a way that is not possible with equation (4.12). Specifically, the coefficients of the change variables give the respective short-run effects, while those of the level variables divided by that of the level of the dependent variable give the long-run effect.

A further manipulation would allow equation (4.13) to be expressed as an error -correction model (4.14), where the term in the squared bracket represents the error-correction term. Suppose there is a sudden increase in m_t, such that the steady state relationship is disturbed, the error-correction term becomes positive. Assuming that ($d_1 < 1$; and therefore $(d_1 - 1) < 0$), the effect of the error-correction term is to reduce the excess growth of m_t, pushing it back towards steady state, or the equilibrium growth level. An opposite scenario can be envisaged if there is a sudden increase in y_t supersede the steady state growth level. Defining the error-correction term as e_t, it can be written as equation (4.15) below

$$e_t = m_t - by_t \tag{4.15}$$

This equation is in fact the long-run equilibrium money demand function (4.2) where the opportunity cost variable and the constant term are omitted and an error term e_t is added.

Two observations can be made about equation (4.14). 1) the error-correction term is specified only in terms of one of the independent variables - the real income, or rather the

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[7] *For example, Δm which is the same as Δ LogM, is in fact approximately equal to the percentage growth rate of* $M_t \left[\frac{M_t - M_{t-1}}{M_{t-1}}\right]$ *to first - order.*

scale variable. Although this can be justified by arguing that the demand for money being analysed is basically that of transactions demand, which is not an unreasonable assumption in countries where there are limited alternative financial assets to money, and where the speculative demand for money may be small. Furthermore, in countries like Nigeria where the interest rate is virtually fixed by the authorities, and therefore, not allowed to fluctuate much, it is reasonable to specify the error-correction in terms of real income alone. It is nevertheless, possible for a disturbance to the steady state relationship to arise from the interest rate or the opportunity cost variable. This problem becomes more pronounced the more independent variables there are in the model. 2) To simplify the estimation of equation (4.14), it is often assumed that the long-run elasticity of money demand with respect to income $((b_0 + b_1)/(1 - d_{1)})$ is equal to unity. Hendry (1979), for example, makes this assumption to estimate the U.K money demand function. It is however, possible to test specifically for this assumption by adding an extra y_{t-1} term to equation (4.14), or estimate equation (4.13) directly instead.

4.5.1 Cointegration and Error-Correction

Two or more series are said to be cointegrated if there is a defined long-run equilibrium relationship between them. More technically, assume that two series Q_t and X_t are both integrated of order one (I(1) - stationary in first difference and not in levels)[8] it is possible for there to be a linear combination of the two variables defined by equation (4.16) below, which is stationary in levels (I(0)).

$$Z_t = Q_t - \Theta X_t \tag{4.16}$$

If such a relationship exists the two series are said to be cointegrated, with Θ being the cointegration parameter (Carruth and Schnabel, 1988). In other words, there is a unique parameter Θ which defines the relationship between Q_t and X_t in the long-run. Although equation (4.16) is defined in terms of two variables only, it is nevertheless, possible to

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[8] *See chapter 3, section 3.4.2 for a detailed discussion about the order of integration of a series and how that can be measured using the ADF - Test.*

extend it to a case of many variables with different cointegration parameters.

When taken in the context of the money demand analysis, equation (4.16) is simply the error-correction term (4.15) defined earlier. The cointegration parameter Θ is the long-run elasticity of money demand with respect to the real income. It follows that if two or more series are cointegrated, it is always possible to construct a model with a valid error-correction term. In fact cointegration is a necessary condition for there to be a stable long-run linear equilibrium relationship between any given set of variables. The validity of specifying the money demand function in the form of equation (4.15) depends on y_t and m_t being cointegrated.

The following can be deduced from the above discussion about cointegration:

1) Equation (4.16) is in fact a long-run equilibrium relationship without a constant term; where Q_t is the dependent variable, X_t the independent variable, Z_t the error term and Θ a parameter which can be defined as an elasticity if the variables are in logarithms.

2) The error-correction term is equal to the error-term of a long-run equilibrium equation.

3) A slightly different strategy for formulating and estimating an error-correction model is suggested. Firstly to estimate a long-run equilibrium relationship suggested by a given theory, and then use the residuals from the regression as the error-correction term. This strategy has the advantage that the error-correction term can be specified in terms of more than one independent variable. In addition, the values of the long-run elasticities are estimated rather than imposed arbitrarily.

Engle and Granger (1987) proposed the following procedure for constructing and estimating an error correction model using the cointegration ideas. The procedure is commonly known as the "Engle-Granger two-step approach". The starting point is to test the integratedness of each individual series (the number of times these series need to be differenced before achieving stationarity). Generally, it is required for the series to be

integrated of the same order. The two methods of testing most often utilised are the Durbin-Watson test (DW) and the Augmented Dickey Fuller test (ADF).[9] The DW test requires that a regression of the series X_t (ΔX_t if testing for I(1)) be run on a constant and test the null hypothesis that the residuals follow a random walk. In other words, for each series X_t *or* ΔX, the null hypothesis is that the first order autocorrelation coefficient is equal to unity. If this hypothesis cannot be rejected, then the series follows a random walk.

If the different series are found to be integrated of the same order, the next step of the approach is to test for cointegration of these series. This is carried out by running a static regression of the level of the dependent variable on the levels of the independent variables (the cointegration regression) and testing the residuals of the regression for stationarity. If the variables are cointegrated, the residuals must be stationary in levels (I(0)). A formal test for cointegration of a set of series would require testing the residuals from the cointegration regression for stationarity, I(0). The null-hypothesis is that the residuals from the cointegration regression contain a unit-root (the residuals are a non-stationary random walk). Rejection of this hypothesis means that the variables are cointegrated and there exists a long-run equilibrium relationship between them. The first kind of test is based on the Durbin-Watson statistic calculated from the cointegration regression. The test is not whether the value of the DW statistic is equal to, or nearly equal to 2 as in the conventional test for first order serial correlation, but rather that d is significantly positive or not. The null that the residual is a non-stationary random walk (has a unit-root), would be rejected if the value of DW is greater than a certain critical value. The appropriate critical values are provided in Sargan & Bhargava (1983). A second kind of test is based on the ADF test described earlier. The appropriate critical values in this case can be found in Engle and Yoo (1987). Either way, if the residuals of the cointegration regression can be shown to be I(0), the null of non-cointegration would

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[9] *see chapter 3 for a discussion on ADF test.*

be rejected for cointegration.

The second step would be (after confirming that the residuals are I(0)) to include a one period lagged value of the residuals variable into an equation that regresses the first difference of the dependent variable on the first difference of the independent series. (here it is assumed that all series are I(1)). The one period lagged residuals of the cointegration regression serves as the error-correction term.

4.6 Identification and Simultaneity Problems

The identification problem in the context of estimating the money demand function arises because the quantity of money demanded cannot be observed directly. Instead, what is observed is the quantity of money supplied or rather the quantity of money in circulation at a given point in time. A money market equilibrium condition is invoked to be able to define the observed stock of money as the quantity demanded. A least squares line fitted through a series of observations of the equilibrium quantity of money across time may represent the money demand function, the money supply function, or neither. If the unobserved demand function were reasonably stable, and the observations are as a result of shifts in the supply function, then a least squares line could be a money demand function. If on the other hand, the money supply function were stable, but the money demand function shifts around, the least squares line will represent the money supply function. If both functions shift around, the least squares line is neither a money demand function, nor a money supply function. Only in the first scenario is the money demand function identified.

The money demand function can therefore be identified if there is one variable which makes the money supply function shift independently of the money demand function. *"Suppose that we believe the demand for nominal balances depend on the level of real income, the price level, and a representative interest rate and the supply to depend on that same interest rate and stock money base available in the economy. Then, if fluctuations in the stock of money base are independent of fluctuations in real income*

and prices or any of the other variables, including the random factors that might cause the demand for money to vary, the parameters of the demand function will be identified", (Laidler, 1985 p. 101). The above statement implicitly assumes that the monetary base is exogenous. However, as discussed in the earlier chapters, the monetary base and the money stock may in fact be endogenous. If the endogeneity is such that the money supply function is horizontal in the money interest rate space, and interest rate targeting is practiced, then the money demand function is identifiable. Changes in the interest rate will lead to shifts in the horizontal money supply function, and generating points that lie on the money demand function. Furthermore, if real rather than the nominal observed quantity of money is used as the dependent variable, and the price level is endogenous, so that it does not appear in the money demand function as an explanatory variable, then the identification problem discussed above will not arise. Unless the monetary authorities can change the price level directly, there will not be a separate supply function for real money balances.

Assuming the money demand function is identified, it is often specified in the context of a single equation model and estimated using ordinary least squares (OLS). The implicit assumption is that the explanatory variables - real income, and the interest rates, for example, are independent of the error term of the equation. Violation of this assumption will lead to simultaneity bias, where the parameter estimates obtained using the OLS technique will be biased and inconsistent.

Following Thomas (1985), the simultaneity problem can be illustrated using a simple model of the money market defined by equations (4.17, 4.18 and 4.19) below.

$$m^d = b_0 + b_1 y + b_2 i + \varepsilon_d \tag{4.17}$$

$$m^s = u + h \qquad where\ u = \log U \text{ and } h = \log H \tag{4.18}$$

$$m^s = m^d \tag{4.19}$$

$$i = \frac{1}{b_2}(u - b_0) - \frac{b_1}{b_2} y + \frac{1}{b_2} h + \frac{\varepsilon_d}{b_2} \tag{4.20}$$

Equation (4.17) is basically the money demand equation (4.2) plus the error term ε_d.

Equation (4.18) is a simple money supply equation where the money stock is defined to be identically equal to the money multiplier (U) times the monetary base (H), and equation (4.19) defines the money market equilibrium condition.

Assume that real income (y) is exogenous. Further assume that the monetary authorities target money supply and use the monetary base (h) as the instrument. In this situation the interest rate adjusts to clear the market. Setting equation (4.17) equal to (4.18) and solving for the interest rate variable gives equation (4.20), which defines the interest rate in terms of the other variables. The error term (ε_d) appears in this equation and is positively correlated with the interest rate variable. If the above assumptions hold, the interest rate variable in the money demand equation will be endogenous and estimating the money demand function using OLS will result in simultaneity bias.

If the monetary authorities target the interest rate, it is the monetary base that adjusts endogenously to clear the market. In this case the interest rate variable is exogenous and will not be correlated with the error-term (ε_d). Unbiased and consistent estimates of the money demand parameters can be obtained by applying the OLS estimation technique, (Thomas, 1985). It has been discussed in chapter 1 that the Nigerian Central Bank has never used open market operations or any other quantitative instruments suitable for targeting money supply. It has used the discount rate which is directly connected to the commercial bank lending and borrowing rates, as an instrument of monetary policy since 1963. This seems to suggest that monetary policy in Nigeria has been geared towards interest rate targeting rather than some monetary aggregate. In view of the above discussions, it is possible for the Nigerian money demand function to be identified. Furthermore, the interest rate variable in the money demand function is expected to be exogenous; implying that a single equation estimation technique can be used to obtain consistent and unbiased parameter estimates.

The most often utilised solution to the simultaneity problem is to use the two stage least squares estimation technique.[10] This technique requires regressing all the

[10] *Alternatively, the money demand function can be set up as one of many equations and a sys-*

endogenous explanatory variables on some variables that are actually exogenous to the system and then using the predicted values from this regression as the explanatory variables in the money demand equation. Empirical studies of the demand for money function often use both OLS and 2SLS to estimate the money demand function. If there is no discernible difference between the results, then the possibility of the simultaneity problem is discounted, (see for example Goldfeld, 1973). Cooley and Leroy (1981) argue that similar OLS and 2SLS results may not be an indication that the simultaneity problem is not important, but rather that the instruments used (the exogenous variables used in the first stage of the two stage least squares) are selected in such a way that the two methods are equally biased.

Although the point presented by Cooley and Leroy (1981), is plausible, Laidler (1985), is inclined to think that it is unduly pessimistic. Furthermore, he argued that the *"the extent to which a particular set of data might suffer from the kind of errors that lead to simultaneous equation bias can be related to the length of the time period it covers and to the time interval over which individual observations are averaged"*. This study, which uses annual data, is therefore less likely to suffer from simultaneity bias.

4.7 Stability of the Money Demand Function

According to Judd and Scadding (1982) a stable demand for money function should 1) have few arguments which are linked in a significant way to the real sector 2) The estimated functions should have significant and theoretically consistent signs, and be able to make an out of sample forecast. According to Hendry (1979), a stable money demand function should be characterised by estimated parameters that are relatively constant over-time and should have good predictive accuracy.

In this section, the stability of the Nigerian money demand function will be investigated by estimating the three different specifications of the money demand

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tems estimation technique like the full informations maximum likelihood (FIML) can be used.

function. The traditional partial adjustment specification represented by equation (4.7), a specification in levels and changes represented by equation (4.13) and a specification in terms of the error-correction and cointegration technique discussed earlier. In addition to investigating the stability issue, this will enable a comparison between the different specifications using the Nigerian data.

The stability test utilised in this study is that suggested by Hendry (1979), based on the out of sample forecasting performance of the estimated models. This test involves estimating the money demand function using only part of the whole sample (leaving out some observations - 1984 to 1989 in this case) and then using the estimated model to forecast the omitted observations. A Chow-test for the forecast period can be used to test the hypothesis that the parameters of the equation are the same for the in-sample and the forecast period. As discussed in chapter 2, for the predictive accuracy of the model, a forecast Chi-squared test can be used to measure how closely the model succeeded in predicting the out of sample observations. In addition, a barrage of diagnostic tests are carried out to ensure that the estimated models have met the regular specification conditions (lack of serial correlation, homoskedasticity, and normality).

The result of estimating the partial adjustment model, equation (4.7) for narrow and broad definition of money (M1 and M2) is reported in Table 4.1. Diagnostic tests reject the hypothesis that the error-terms of the regression are serially correlated, heteroskedastic and non-normal. All the explanatory variables are significant and carry theory consistent signs except the opportunity cost of holding money which is not significant.[11] The adjustment coefficients (one minus the coefficient of the lagged dependent variables) are (0.50) and (0.63) for M1 and M2 respectively. This indicates that about 50 and 60 percent of any adjustment towards the desired or the equilibrium quantity of money holding is achieved one year after any disturbance. In other words,

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[11] *The treasury bills rate is used to represent the opportunity cost of holding money. Discount rate and savings/deposits rate (M2's own rate of return) did not yield any better result.*

ceteris paribus, it will take about two years for adjustment towards equilibrium to be completed. The short-run income elasticities of money demand are (0.88) for both M1 and M2. Dividing that by the respective adjustment coefficients, renders long-run elasticities of (1.76) and (1.40) for M1 and M2 respectively.[12] Casual observation of these elasticities indicate that they are greater than one and therefore, it may not be appropriate to estimate an error-correction model, specified in the form of equation (4.14), which assumes a priori that the long-run income elasticity of money demand is unity. However, given the analytical weakness of the partial adjustment specification discussed earlier, a further investigation is necessary. A forecast $\chi^2(5)$ value of 4.25 and 1.6 for M1 and M2 and a Chow-test for the forecast period value of ($F(5, 18) = 0.63$ for M1 and $F(5, 16) = 0.30$ for M2) indicate that the hypothesis that this empirical model is stable cannot be rejected.

The above result is arrived at after a set of step dummy variables, to capture the effect of the shocks to the Nigerian economy, outlined in chapter 2 were used in the modelling process. However, in the context of the money demand, these dummies are hard to justify. For example, it is not clear, besides the income effect which is captured by the income variable, how the 1973/74 oil price shock affected the quantity of money demanded in Nigeria. It is therefore, necessary to re-estimate this and the other specifications of the money demand function without these dummy variables. The result of the partial adjustment specification without dummies is presented in Table 4.1.1. In fact, it is not very different from the one in Table 4.1. The models without dummies are quite stable as indicated by the outcome of the battery of diagnostic tests and the forecast ability tests. Furthermore, the adjustment coefficients of 0.61 and 0.66 are not

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[12] *It is unusual for the long-run income elasticity of narrow money to be greater than that of broader money. This result implies that narrow money is more of a luxury than a broad money. This may be due to the fact that in Nigeria, current accounts are more of a luxury than savings account. There are strickter requirement for openning a current account than a savings account. In fact, most lower level wage workers that are not paid in cash are paid through the banks via savings account.*

Table 4.1

Money Demand Function with step Dummies (Partial Adjustment Specification)		
Variables	Narrow Money	Broad Money
Const.	-7.48 (-3.73)	-6.48 (-3.55)
Log $(M1/P)_{t-1}$	0.50 (4.62)	- -
Log $(M2/P)_{t-1}$	- -	0.37 (3.14)
Log GDP	0.88 (4.60)	0.88 (4.86)
Log TBR	-0.10 (-0.21)	-0.04 (-0.63)
DUM1967/68	- -	-0.15 (-2.34)
DUM1970/71	0.35 (2.74)	0.29 (2.60)
DUM1973/74	-0.22 (-2.54)	-0.18 (-2.24)
DUM1979/80	- -	-0.21 (-2.59)
R^2	0.98	0.99
Std. Err.	0.10	0.09
LM-Test for 1^{st} Order Serial Correlation	F(1, 22) 0.04	F(1, 20) 1.13
LM-Test for 2^{nd} Order Serial Correlation	F(2, 21) 2.71	F(2, 19) 1.90
ARCH-Test for 1^{st} Order Heteroskedasticity	F(1, 21) 0.19	F(1, 19) 0.13
ARCH-Test for 2^{nd} Order Heteroskedasticity	F(2, 19) 0.13	F(2, 17) 0.04
Normality -Test	$\chi^2(2)$ 0.321	$\chi^2(2)$ 1.02
Forecast Accuracy Test	$\chi^2(5)/5$ 0.85	$\chi^2(5)/5$ 0.32
Chow-Test for Forecast Period	F(5, 18) 0.63	F(5, 16) 0.30

Dependent Variables: Log(M1/P), and Log(M2/P).
t-values are in parenthesis
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 4.1.1

Money Demand Function with no Dummies (Partial Adjustment Specification)		
Variables	Narrow Money	Broad Money
Const.	-4.40 (-3.21)	-4.10 (-2.66)
Log $(M1/P)_{t-1}$	0.61 (5.29)	- -
Log $(M2/P)_{t-1}$	- -	0.66 (5.59)
Log GDP	0.56 (3.42)	0.52 (2.86)
Log TBR	-0.006 (-0.095)	0.015 (0.24)
DUM1967/68		
DUM1970/71		
DUM1973/74		
DUM1979/80		
R^2	0.96	0.97
Std. Err.	0.126	0.119
LM-Test for 1^{st} Order Serial Correlation	F(1, 24) 0.18	F(1, 24) 0.01
LM-Test for 2^{nd} Order Serial Correlation	F(2, 23) 0.50	F(2, 23) 0.17
ARCH-Test for 1^{st} Order Heteroskedasticity	$\chi^2(1)$ 0.14	$\chi^2(1)$ 0.09
Normality -Test	$\chi^2(2)$ 0.47	$\chi^2(2)$ 0.26
Forecast Accuracy Test	$\chi^2(5)/5$ 0.66	$\chi^2(5)/5$ 0.27
Chow-Test for Forecast Period	F(5, 20) 0.28	F(5, 20) 0.26

Dependent Variables: Log(M1/P), and Log(M2/P).
t-values are in parenthesis
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

statistically different from those given by the models with dummy variables. The short-run income elasticities of 0.56 and 0.52 for narrow and broad money are less than the 0.88 obtained in the earlier models. Similarly, the long-run income elasticities of 1.44 and 1.53 for narrow and broad money are less than those obtained when dummy variables were used. Also, in this model unlike in the earlier one, the income elasticity for broad money is higher than that for narrow money, although the difference may not be statistically significant.

The result of estimating the money demand function, specified as a general autoregressive distributed lag model, reparameterised into levels and changes (equation 4.13), is presented in Table 4.2. As discussed earlier, this model has the advantage that it does not impose the same cost of adjustment with respect to all the independent variables. As in the partial adjustment case, the empirical models pass the battery of standard diagnostic tests. The forecast chi-squared and the Chow-test for the forecast period also show that the functions are stable. It is most interesting to note that the short-run income elasticity of money demand of (1.00) and (1.05) (coefficient of the change variables) and long-run values of (1.74) and (1.37) (coefficients of the level variables divided by minus the coefficient of the lagged level of the dependent variable) for M1 and M2, are virtually the same as the values obtained using the partial adjustment specification. These results, firstly, seem to confirm the suspicion raised by the partial adjustment specification that the long-run income elasticity of money demand is likely to be greater than unity. Secondly, they seem to suggest that the partial adjustment specification may in fact be an adequate representation of money demand in Nigeria. The interest rate variable as in the partial adjustment specification, although of the expected sign, is not statistically significant.

The result of estimating this equation without the dummy variables is presented in Table 4.2.1. Here as well, the hypothesis that the models are stable could not be rejected. Unlike the partial adjustment models, the coefficient estimates in this case are weaker as

Table 4.2

Money Demand Function (Variables in Levels and Changes)		
Variables	Narrow Money	Broad Money
Const.	-4.97 (-1.86)	-3.80 (-1.38)
Log $(M1/P)_{t-1}$	-0.34 (-3.05)	- -
Log $(M2/P)_{t-1}$	- -	-0.38 (-2.84)
Δ Log GDP	1.00 (5.10)	1.05 (5.25)
$(LogGDP)_{t-1}$	0.59 (2.27)	0.52 (1.86)
Δ Log TBR	-0.35 (-1.62)	-0.17 (-0.82)
$(LogTBR)_{t-1}$	- -	- -
DUM 1970/71	0.26 (1.80)	0.15 (1.08)
DUM 1973/74	-0.23 (-2.84)	-0.20 (-2.44)
DUM 1979/80	- -	-0.09 (-1.32)
R^2	0.71	0.68
Std. Err.	0.093	0.090
LM-Test for 1^{st} Order Serial Correlation	F(1, 21) 2.68	F(1, 20) 2.33
LM-Test for 2^{nd} Order Serial Correlation	F(2, 20) 3.36	F(2, 19) 1.54
ARCH-Test for 1^{st} Order Heteroskedasticity	F(1, 20) 0.10	F(1, 19) 0.38
ARCH-Test for 2^{nd} Order Heteroskedasticity	F(2, 18) 0.31	F(2, 17) 0.92
Normality Test	$\chi^2(2)$ 0.57	$\chi^2(2)$ 0.29
Forecast Accuracy Test	$\chi^2(5)/5$ 0.84	$\chi^2(5)/5$ 0.62
Chow-Test for Forecast Period	F(5, 17) 0.77	F(5, 16) 0.48

Dependent Variables: ΔLog(M1/P) and Δ Log(M2/P).
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 4.2.1

Money Demand Function with no Dummies (Variables in Levels and Changes)		
Variables	Narrow Money	Broad Money
Const.	-2.61 (-1.90)	-2.01 (-1.50)
Log $(M1/P)_{t-1}$	-0.17 (-1.40)	- -
Log $(M2/P)_{t-1}$	- -	-0.15 (-1.41)
Δ Log GDP	0.89 (3.73)	0.89 (3.40)
$(LogGDP)_{t-1}$	0.31 (1.80)	0.25 (1.52)
Δ Log TBR	-0.34 (-1.33)	-0.18 (-0.80)
$(LogTBR)_{t-1}$	- -	- -
DUM 1970/71		
DUM 1973/74		
DUM 1979/80		
R^2	0.51	0.50
Std. Err.	0.114	0.106
LM-Test for 1^{st} Order Serial Correlation	F(1, 23) 0.16	F(1, 23) 0.77
LM-Test for 2^{nd} Order Serial Correlation	F(2, 22) 0.08	F(2, 22) 0.39
ARCH-Test for 1^{st} Order Heteroskedasticity	$\chi^2(1)$ 1.06	$\chi^2(1)$ 2.32
Normality Test	$\chi^2(2)$ 0.44	$\chi^2(2)$ 0.10
Forecast Accuracy Test	$\chi^2(5)/5$ 0.55	$\chi^2(5)/5$ 0.36
Chow-Test for Forecast Period	F(5, 19) 0.53	F(5, 19) 0.32

Dependent Variables: ΔLog(M1/P) and Δ Log(M2/P).
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

shown by the low t-values. In fact all of the coefficients, with the exception of that representing the impact effect of the real income, are significant only at the 10 percent level. The impact elasticity of 0.89 for narrow and broad money are not statistically different from the values of 1.00 obtained when step dummies were used. The long-run income elasticities of 1.82 and 1.67 for narrow and broad money are also only slightly different from 1.74 and 1.37 obtained earlier.

Unlike in the case where dummy varibles are used, the short-run income elasticities obtained from the partial adjustment and those obtained from the models in levels and changes are quite different, but the long-run elastities are still quite close, and in both cases they are greater than unity.

Table 4.3

Order of Integration of the Series ADF-Test					
VARIABLES	ADF-TEST FOR I(0)		ADF-TEST FOR I(1)		ORDER OF INTEGRATION
	(LEVELS)		(FIRST DIFFERENCE)		
	COEFF	t-VALUES	COEFF	t-VALUES	
Log(M1/P)	-0.05	(-1.08)	-1.20	(-4.09)	I(1)
Log(M2/P)	-0.05	(-1.30)	-1.23	(-4.05)	I(1)
LogGDP	-0.06	(-1.48)	-0.76	(-3.22)	I(1)
Log TBRT	0.02	(0.20)	-0.82	(-3.17)	I(1)
Log SRT	0.05	(0.99)	-0.61	(-2.67)	I(1)
Log DRT	0.11	(1.33)	-0.75	(-2.82)	I(1)

ADF-Test requires running the following:

$$\Delta X_t = a + bX_{t-1} + \sum_{i=1}^{n} \Delta X_{t-i} + e_t$$

Coeff. represents the estimates of b, with t-values in parenthesis.
Critical t-values for ADF-Test are -3.75(1%), -3.00(5%), -2.63(10%); for N=25.

It has been discussed earlier that there are advantages to specifying the money demand function in an error-correction form. Evidence from estimating the other formulations shows that the long-run income elasticity of money demand is greater than unity. It is therefore, not appropriate to estimate equation (4.14) which uses such an assumption. Instead the Engle-Granger two-step procedure, which involves the idea of cointegration is adopted to formulate and estimate an error-correction model of Nigerian money demand.

One of the necessary conditions for a valid cointegration analyses is for for the variables to be integrated of the same order. The result of testing the integratedness of each series is reported in Table 4.3. Augmented Dickey Fuller (ADF) tests showed that all the series are integrated of the same order (I(1) - achieve stationarity after differencing once). The next stage of the Engle - Granger approach is to test for cointegration across the series. In other words, to investigate whether a long-run relationship in fact exists between real money holdings, real income, and the nominal interest rate. For this purpose, a regression of the level of real money balances is run on the levels of the dependent variables (cointegration regression), and the result of that is reported in Table 4.4. Cointegration Regression Dubin-Watson (CRDW) of (1.44) and (1.88) suggest that the null that the variables are cointegrated in a long-run relationship cannot be rejected. Furthermore, testing the residuals from the cointegration regression for stationarity using the ADF test gave t-values on the one-period lagged residuals as (-4.50) and (-5.0) for M1 and M2 respectively, further re-enforcing the conclusion that the variables are cointegrated.

The result of estimating an error-correction model, where one period lagged residuals from the cointegration regressions are used as the error-correction terms is, presented in Table 4.6. Tests carried out in a similar manner to the earlier models show that these models also pass all the regular diagnostic and stability tests. The error-correction terms are statistically significant for both M1 and M2. Furthermore, the coefficient values of (-0.09) and (-0.08) on the error-correction terms indicate that the dynamics of the systems are stable. However, while the other two specifications gave a similar degree of adjustment for M1 and M2, this specification seems to suggest an adjustment of M2 considerably faster than that of M1.

The short-run or the impact income elasticity of money demand of (1.07) and (0.87) for M1 and M2 are very close to the ones obtained from the two earlier models. The long-run elasticity of income which is to be read off straight from the cointegration

regression are (1.22) and (1.23) for M1 and M2. The value for M2 is quite close to the values obtained from the other models. For M1, it is considerably smaller than (1.76) and (1.74) reported from the two earlier models. The Interest rate variable, although of the expected sign, is characteristically insignificant in this model as well.

The result that the variables are cointegrated in a long-run equilibrium relationship was obtained only after inclusion of the set of step dummy variables mentioned earlier. Without the dummy variables, the (CRDW) values are 0.58 and 0.62, while the t-values on the one period lagged residuals, using ADF-test are (-2.60) and (-2.56) for M1 and M2 respectively (see Tables 4.4.1 and 4.5.1). The critical (CRDW) at 5% is about 0.827, while that of the ADF-test with two explanatory variables is about -3.0. Without the dummy variables, the null hypothesis that the variables are cointegrated in a long-run relationship is rejected on both counts. Furthermore, the interest rate variable in the long-run cointegration regression without dummies are significant but of the wrong signs, which may imply a misspecification.

The cointegration tests utilised above are large sample tests. Results from small samples may not be very relaible. According to Engle and Granger, 1987 if a valid error-correction term can be established, then the variables must be cointegrated in a long-run relationship. As a further test of the cointegratedness of the varibles, an error-correction model can be estimated and the validity of the error-correction term checked. The result of estimating such a model without the dummy variables is presented in Table 4.6.1. The standard tests show that the models are stable. Furthermore, the coefficients of the real income and the interest rate are of the expected sign, with the latter characteristically insignificant. The error-correction terms have the expected signs and have values of less than one in absolute value but are not significant. This seem to reinforce the conclusion from the ADF and CRDW tests that there is no cointegration between the variables. Modelling the Nigerian money demand using the Engle-Granger two steps approach, therefore, may not be valid.

Table 4.4

Cointegration Regression Equations		
Variables	Narrow Money	Broad Money
Const.	-8.71 (-4.02)	-8.20 (-4.36)
Log GDP	1.22 (6.40)	1.23 (7.43)
Log TBR	-0.08 (-1.04)	-0.12 (-1.33)
DUM 1967/68	- -	-0.21 (-3.22)
DUM 1970/71	0.27 (1.89)	0.28 (2.37)
DUM 1973/74	-0.30 (-3.09)	-0.22 (-2.77)
DUM 1979/80	-0.29 (-3.00)	-0.31 (-3.95)
DUM 1981/82	- -	-0.19 (-1.97)
R^2	0.97	0.99
Std. Err.	0.12	0.097
CRDW	1.42	1.88

Dependent Variables: Log(M1/P) and Log(M2/P).
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 4.4.1

Cointegration Regression Equations with no Dummies		
Variables	Narrow Money	Broad Money
Const.	-10.73 (-12.40)	-12.17 (-14.36)
Log GDP	1.35 (16.51)	1.50 (18.82)
Log TBR	0.15 (2.06)	0.25 (3.49)
R^2	0.92	0.94
Std. Err.	0.18	0.17
CRDW	0.58	0.62

Dependent Variables: Log(M1/P) and Log(M2/P).
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 4.5

ADF-Test Cointegration Regression Residuals for I(0)		
Variables	Narrow Money	Broad Money
Const.	-0.011 (-0.07)	-0.001 (-0.02)
$(\Delta ECT\,1)_{t-1}$	0.38 (2.07)	- -
$(ECT\,1)_{t-1}$	-0.98 (-4.50)**	- -
$(\Delta ECT\,2)_{t-1}$	- -	0.36 (1.94)
$(ECT\,2)_{t-1}$	- -	-1.27 (-5.00)**

Dependent Variables: $\Delta ECT\,1$, and $\Delta ECT\,2$, where ECT represents the residuals from the conitegration regression.
ECT: Residuals from the cointegration regressions (Table 4.4)
** the relevant t-values for cointegration test.

Table 4.5.1

ADF-Test Cointegration Regression Residuals for I(0)		
Variables	Narrow Money	Broad Money
Const.	-0.002 (-0.072)	-0.001 (-0.04)
$(\Delta ECT\,1)_{t-1}$	0.31 (1.60)	- -
$(ECT\,1)_{t-1}$	-0.38 (-2.61)**	- -
$(\Delta ECT\,2)_{t-1}$	- -	0.29 (1.48)
$(ECT\,2)_{t-1}$	- -	-0.40 (-2.56)**

Dependent Variables: $\Delta ECT\,1$, and $\Delta ECT\,2$, where ECT represents the residuals from the conitegration regression.
ECT: Residuals from the cointegration regressions (Table 4.4.1)
** the relevant t-values for cointegration test.

Table 4.6

Money Demand Function Error-Correction and Cointegration		
Variables	Narrow Money	Broad Money
Const.	0.04 (1.70)	0.02 (0.33)
Δ Log GDP	1.07 (6.11)	0.87 (5.68)
Δ Log TBR	-0.06 (-0.55)	-0.002 (-0.22)
$(ECT\,1)_{t-1}$	-0.09 (-4.34)	- -
$(ECT\,2)_{t-1}$	- -	-0.80 (-4.27)
DUM 1967/68	-0.10 (-1.80)	- -
DUM 1970/71	0.16 (2.42)	0.11 (2.24)
DUM 1973/74	-0.13 (-2.28)	-0.14 (-2.73)
DUM 1981/82	- -	0.07 (1.70)
R^2	0.76	0.78
Std. Err.	0.084	0.074
LM-Test for 1^{st} Order Serial Correlation	F(1, 21) 0.01	F(1, 20) 1.92
LM-Test for 2^{nd} Order Serial Correlation	F(2, 20) 0.36	F(2, 19) 1.59
ARCH-Test for 1^{st} Order Heteroskedasticity	F(1, 20) 0.12	F(1, 19) 0.14
ARCH-Test for 2^{nd} Order Heteroskedasticity	F(2, 18) 0.56	F(2, 17) 0.73
Normality - Test	$\chi^2(2)$ 1.39	$\chi^2(2)$ 0.078
Forecast Accuracy Test	$\chi^2(5)/5$ 2.14	$\chi^2(5)/5$ 0.68
Chow-Test for Forecast Period	F(5, 17) 1.67	F(5, 17) 0.52

Dependent Variables: $\Delta LogM\,1/P$, $\Delta LogM\,2/P$.
ECT - Residuals from the Cointegration Regressions.
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

Table 4.6.1

Money Demand Function with no Dummies Error-Correction and Cointegration		
Variables	Narrow Money	Broad Money
Const.	0.02 (1.00)	0.37 (1.68)
Δ Log GDP	0.93 (4.03)	0.90 (4.32)
Δ Log TBR	-0.19 (-0.78)	-0.16 (-1.12)
$(ECT\,1)_{t-1}$	-0.18 (-1.29)	- -
$(ECT\,2)_{t-1}$	- -	-0.09 (-0.69)
DUM 1967/68		
DUM 1970/71		
DUM 1973/74		
DUM 1981/82		
R^2	0.47	0.49
Std. Err.	0.124	0.10
LM-Test for 1^{st} Order Serial Correlation	F(1, 24) 0.02	F(1, 24) 0.66
LM-Test for 2^{nd} Order Serial Correlation	F(2, 23) 0.08	F(2, 23) 0.41
ARCH-Test for 1^{st} Order Heteroskedasticity	F(1, 23) 0.49	F(1, 23) 0.26
Normality - Test	$\chi^2(2)$ 0.35	$\chi^2(2)$ 0.006
Forecast Accuracy Test	$\chi^2(5)/5$ 0.55	$\chi^2(5)/5$ 0.39
Chow-Test for Forecast Period	F(5, 20) 0.48	F(5, 20) 0.33

Dependent Variables: $\Delta LogM\,1/P$, $\Delta LogM\,2/P$.
ECT - Residuals from the Cointegration Regressions.
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

One of the reasons for investigating the stability of the Nigerian money demand relationship is to make a statement about the abilities of the Nigerian Monetary Authorities to control the quantity of money stock for monetary policy purposes. In view of the conclusion from the last chapter (the monetary base and the money stock in Nigeria are likely to be endogenously determined by the demand for money), the money stock can only be controlled through the money demand. Although all the different specifications showed that the Nigerian money demand function is stable, the interest rate variable, which is the only likely control variable in the money demand function, is not significant. In this study, the treasury bills rate is utilised. Two other interest rate variables (the discount rate and the deposits rate) rendered not only statistically insignificant coefficients, but signs which are inconsistent with the theory as well. Given that the interest rate variable is insignificant, it is not possible for the Nigerian Monetary Authorities to significantly change the quantity of money demanded and thus the quantity supplied, through the interest rate variable. This may seem to indicate that the monetary authorities cannot effectively change the money stock for monetary policy purposes and therefore cast some doubts upon its ability to conduct effective and independent monetary policy.

However, in spite of the fact that the Central Bank of Nigeria has changed the interest rates for policy purposes, the year to year variation may in fact be very small. The insignificance of the interest rate variable in the money demand functions may therefore, be as a result of lack of variability. In the light of this possibility, as discussed earlier, alternative proxies for the opportunity cost of holding money can be used. One such alternative suggested is the expected inflation rate. There are two problems to using the expected inflation variable in this study. Firstly, as a result of the problems associated with defining expectations, it is difficult to construct this variable. Secondly, even if a suitable variable can be found to represent the expected inflation, it is not possible for a country's central bank to use it as a policy instrument for the purpose of

controlling money demand and thus the money supply, in an endogenous money economy. Its use in this study will serve no purpose. Another proxy suggested is the degree of credit restraint. Wong (1977) for example argues that the interest rate is relevant in the money demand function of developing countries. However, the relevant interest rates are not the ones charged by banks and other financial institutions which are pegged by the government, but rather the unobservable ones in the unorganised sector. Availability of credit in the organised market affects the unobservable interest rate in the unorganised market. For example, if the amount of credit available through the commercial banks is reduced, those in need of credit will turn to the unorganised market and thus raise the demand for credit and the interest rate. In the face of the fact that most developing countries use credit control as a tool of monetary policy, a variable which reflects the degree of credit restraint can be a good proxy for the unobserved interest rate of the unorganised money markets. Proxies for the credit restraint variable suggested for example, includes the discount rate, the rate of domestic credit expansion, etc., (see Wong, 1977 p. 65).

Although the idea of using credit restraint as a proxy for the interest variable in the money demand function of developing countries may be reasonable, its importance in this study is very limited because of the following: Firstly, the strong dichotomy of the financial sector of a country into organised and un-organised sectors may be true of some developing countries, but not all. Unlike most Asian countries, the unorganised market for loans - Landlords, etc, are not a prevalent feature of Nigerian society. There are of course other sources of credit besides the organised market, e.g relatives and friends. However, the driving force in these alternative sources is not the interest rate. Secondly, although Nigeria has been using credit controls and credit guide lines for monetary policy purposes, with varying degrees of success, its effectiveness as a tool of monetary policy arises directly through the money supply via the credit supply and not through the money demand function. The effectiveness of credit controls on the money stock has been

acknowledged even by the most ardent Post-Keynesians, (see for example, Moore 1988, p 163). The use of a credit restraint variable to represent the opportunity cost of holding money is not appropriate for the purpose at hand.

4.8 Summary and Conclusion

In a system where the money stock is endogenously demand determined, any change in the quantity supplied can only be achieved through a change in the demand for it. A necessary condition for the successful conduct of monetary policy in this system is therefore the stability of the money demand function.

A stability test based on forecast accuracy and parameter constancy of estimated models revealed that money demand function specified in the traditional partial adjustment way, plus two other ways (specified with variables in levels and changes and in the form of error-correction and cointegration), are all stable. However, the interest rate variable is not significant in all cases. This implies that the Nigerian Monetary Authorities cannot significantly change the money demand by using the interest rate as an instrument. Therefore, they may not have any significant control over the money stock. However, it is important to note that the Nigerian Monetary Authorities, in addition to the interest rate, have been using direct credit controls, which by-passes the money demand function and directly work on the money stock. As discussed in chapter 1, this has had only a limited degree of success.

Chapter 5

Monetary Approach to Balance of Payments Theory and Offset to the Domestic Component of the Monetary Base

5.1 Introduction

In Chapter 3 it was briefly stated that in a small open economy characterised by a fixed exchange rate regime, the central bank may not be able to change the monetary base in the long-run because it is endogenous. Change in the domestic component of the monetary base, carried out with the aim of altering the monetary base for monetary policy purposes, is likely to be offset by an equal but opposite change in the foreign component. Within the framework of the money multiplier theory of money stock determination, this may mean that a country's monetary authorities are likely to have a very limited scope for an independent monetary policy.

Investigating the degree to which a country's foreign component of the monetary base offsets changes in the domestic component requires estimating a term commonly known as "the offset coefficient", (see for example Kamas (1985), (1986)). An equation expressing change in the net foreign assets of the central bank (ΔNFA) as a function of the change in the net domestic assets (ΔNDA) and other exogenous variables is normally specified and estimated. The coefficient of change in the net domestic assets variable is the offset coefficient.[1]

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[1] *Offset to the domestic component of the monetary base by the foreign component, is commonly referred to as the balance of payments offset to domestic monetary policy. The justification lies in the fact that (1) in a fixed exchange rate regime, changes in the net foreign assets of a central bank reflects changes in the balance of payments position of a country. This definition of the balance of payments corresponds to the official reserve settlements (ORS) definition; (2) changes in the domestic component of the monetary base always reflects the desire by the central bank to change the monetary base for monetary policy purposes.*

[1] *Therefore, here and elsewhere in this and the next chapter, the terms "net foreign assets of the central bank", "the foreign currency reserves of the central bank" and "the balance of payments" are used interchangeably. While changes in the net domestic assets of the central bank (made up of its credit to the government, to the banks and to other non-bank public and private institutions) is taken to be synonymous with monetary policy, change in the money stock, or change in the money supply.*

The offset coefficient is often formulated and estimated in the context of the monetary approach to the balance of payments theory. The central point of this theory is that, the balance of payments is essentially a monetary phenomenon. Balance of payments disequilibria are basically identified with adjustment in the money market. A balance of payments deficit, for example, reflects excess supply of money as a stock.

The most often utilised equations for the purpose of estimating offset coefficients are called the reserve flow and the capital flow equations, (see Laskar (1983), Kouri and Porter (1974), Watson (1988) to name but a few). The reserve flow equation expresses the rate of change in net foreign assets of the central bank (the foreign component of the monetary base) as a function of the rate of change in the net domestic asset (the domestic component of the monetary base), rate of change in the money multiplier and rate of change in the variables determining money demand. The capital flow equation, on the other hand, expresses the net private capital flow as a function of a change in domestic component of the monetary base, level of current account balances, and other exogenous variables.

Generally, in these analyses, the domestic component of the monetary base (the net domestic assets of the central bank), is taken as an exogenous control variable, used by the monetary authorities as an instrument for controlling the money supply. The foreign component of the monetary base is assumed to be beyond the direct control of the domestic monetary authorities. The offset coefficient is represented by the estimated coefficient of the domestic component of the monetary base in the reserve flow and the capital flow equations.

The value of the offset coefficient is expected to be between zero and minus one. A minus one value is taken to indicate that the offset to the domestic component of the monetary base is complete. Any change in the domestic component of the monetary base will be matched by an equal but opposite change in the foreign component, such that the monetary base remains at its initial level. If on the other hand, the offset coefficient turns

out to be zero, it means the domestic component of the monetary base is not affected by the foreign component and therefore, the central bank should be able to change the monetary base as desired. An offset coefficient value of between zero and minus one is an indication of some offset but not complete.

The monetary approach to the balance of payments theory asserts that in a small open economy characterised by a fixed exchange rate regime, the offset coefficient is exactly minus one. This implies that in this type of economy the central bank cannot change the monetary base, and therefore, the money stock for monetary policy purposes.

The monetary approach theory and its method of estimating the offset coefficient have been criticised on many grounds. For example, the approach has been criticised for ignoring the effect of the government budget deficit on the change in the domestic component of the monetary base. Furthermore, it has been argued that using the equations derived in the context of the monetary approach theory for estimating the offset coefficient, gives a result that is biased towards minus one. In fact, it has been shown that the estimated coefficient of the variable representing change in the domestic component of the monetary base in the reserve flow equation is nothing but an estimate of minus one, (see for example Frenkel et al 1980). The assumption that sterilisation does not occur, and that domestic income, prices, and interest rates cannot be changed even in the long-run is also considered to be too restrictive.

Some of the above short-comings of the monetary approach to the balance of payments theory are as a result of its concentration on the money market alone. These weaknesses can be partially corrected by the use of a more general model, encompassing not only the assets market, but the goods market as well as the external sector of the economy.

The aim of this chapter is twofold. Firstly it will try to discuss the monetary approach to the balance of payments theory, and how the offset to the domestic component of the monetary base is measured in that context. Secondly, it will explore

alternative ways of specifying and measuring the offset coefficient, that takes in to account some of the weaknesses of the reserve flow equation, with a view to using it in the next chapter to estimate the offset coefficient for Nigeria.

The remainder of this chapter is organised as follows: In section (5.2) the proposition that the balance of payments is essentially a monetary phenomenon is examined in relation to a fixed exchange rate regime. In sections (5.3) and (5.4), the standard reserve and capital flow equations are derived and discussed. Section (5.5) looks at the sterilisation issue, discussing in detail how it can be measured. Section (5.6) examines the relevance of the monetary approach theory to the developing countries in general and the countries of ECOWAS in particular. Section (2.7) takes up the critique of the monetary approach. In section (2.8) broader models than those used by the proponents of the monetary approach are examined, showing how their use can handle some of the short-comings of the monetary approach, and how the monetary approach and the Keynesian approach to the balance of payments can be reconciled. Lastly in section (2.9) the summary and conclusion to the chapter is presented.

5.2 Monetary Approach to the Balance of Payments Theory

The starting point of the monetary approach to the balance of payments theory is the assertion that the balance of payments is essentially a monetary phenomenon. The balance of payments can be broadly defined as the difference between aggregate receipts and aggregate payments by residents, (Johnson 1976, p. 5). A balance of payments deficit would arise when there is an excess of payments over receipts by residents. Under a fixed exchange rate regime, this deficit would mean that domestic money stock is falling, as it is being transferred to the foreign exchange authorities. For a given desired level of money stock, this will create a disequilibrium in the money market (excess demand for money). To bring the money market back into equilibrium, the interest rate would have to rise. A rise in the domestic interest rate triggers two sets of events which work to eliminate the balance of payments deficit. Firstly, a higher interest rate will

cause a decline in investment, aggregate income, and thus aggregate expenditure on domestic as well as foreign goods and services. Secondly, it will encourage capital inflows. In both cases, the rise in the interest rate works to reduce excess of payments over receipts by residents (the balance of payments deficit). In the former case, payments by domestic residents for foreign goods and services are reduced, thus affecting the current account, while in the latter case, the residents' receipts from sales of assets increases, improving the capital account balance. This adjustment process will continue until the money market disequilibrium is corrected, at which point the balance of payments deficit would also have been corrected.

The above analysis implies that a stock balance of payments deficit triggered by an exogenous factor, leads to a disequilibrium in the money market. It also implies that the process of re-establishing money market equilibrium automatically leads to a correction in the balance of payments deficit. In other words, a stock balance of payments deficit has monetary consequences, and in the long-run it will correct itself.

The monetary nature of the balance of payments can also be shown from another angle. Starting from a full equilibrium condition, if the monetary authorities for example, increase the domestic component of the monetary base (the net domestic assets of the central bank) by open market purchases of government bonds, "ceteris paribus", the immediate (short term) effect is to create excess supply of money as a stock (a disequilibrium in the money market). To bring the money market back into equilibrium, the domestic interest rate would have to fall. At first this will lead to an increase in investment, and then income, and therefore expenditure on foreign, as well as domestic goods and services, thus creating a current account deficit. Secondly, it will encourage capital outflows and thereby leading to a capital account deficit as well. The excess supply of the money stock has ended up creating a balance of payments deficit as the excess money is transferred abroad.

In a fixed exchange rate regime, the above type of deficit is financed through change

in the foreign reserves holding of the central bank (foreign component of the monetary base). Domestic residents wanting to invest abroad or to purchase foreign goods and services, for reasons given above, can only do so in foreign currencies. The necessary foreign currencies are obtained from the domestic monetary authorities, in exchange for the residents' excess domestic currency. This activity will lead to the following: As residents transfer their excess domestic currency to the monetary authorities, the difference between their desired and actual money stock will start to disappear. Secondly, the amount of foreign exchange reserves in possession of the monetary authorities will start to decline, which in effect leads to a decline in the monetary base and the money stock. These movements will go on until all excess supply of money is dissipated and the money market equilibrium is re-established. At this point the balance of payments deficit would have been automatically corrected as well.

The adjustment process described above occurs in the short-run. In the long-run (when the adjustment is completed), the money supply would have returned to its initial level, and so have all real variables and prices. The only change would be the increase in the domestic component of the monetary base being matched, one for one, by an equal decline in the foreign component (foreign reserves in the possession of the monetary authorities). This conclusion is only true for a once and for all increase in the domestic component of the monetary base. In other words, a systematic neutralisation operation by the monetary authorities (sterilisation) is ruled out. The conclusion, however, stands irrespective of the assumption about capital mobility and its responsiveness to interest rate changes, (Swoboda 1976, Mundel 1962).

A stock balance of payments deficit, initially triggered by either an exogenous non-monetary factor or by an increase in the money supply over demand, is temporary because of the automatic adjustment process described above. This adjustment process may be prevented from setting in if the monetary authorities continue to expand the domestic component of the monetary base. In this case, the temporary balance of

payments deficit will be turned into a chronic balance of payments deficit. In essence, this would mean that a chronic stock balance of payments deficit is the result of the monetary authorities' excessive credit creation activities, and that a stock balance of payments deficit in the long-run is basically a monetary phenomenon.

A definition of the balance of payments most often used in the monetary approach analysis is the definition in terms of official settlement, or the central bank balance sheet. The central bank balance sheet is made up of its foreign asset holdings (whose changes reflect the balance of payments position) and domestic asset holdings (central bank credit) on the assets side, and the monetary base on the liability side. The monetary base (high powered money) is created when the central bank acquires assets in the form of foreign assets (foreign currency, etc), or domestic assets (loans to domestic public and private institutions - central bank credit). The central bank pays for these assets by issuing cheques on itself which get deposited in commercial banks and end up as money, (Rivera-Batiz & Rivera-Batiz 1985). For a given amount of the central bank credit, any change in the monetary base is directly reflected in changes in the foreign reserves. This further asserts the monetary nature of the balance of payments.

Generally a balance of payments problem is seen, by the proponents of the monetary approach, as a phenomenon representing a disequilibrium in the money market with the disequilibrium corrected by change in international reserves. An increase in the money supply, such that actual cash balances exceed desired cash balances, will lead to a balance of payments deficit as residents exchange excess money for foreign goods and assets.

The proposition that the balance of payments is essentially a monetary phenomenon does not mean that the balance of payments is not affected by real forces but rather that these real forces operate indirectly through the money supply or the money demand, (Akhtar 1978). Assuming equilibrium in the money market and utilising the central bank balance sheet, the balance of payments can be expressed algebraically as NFA = M -

NDA, (NFA stands for the central banks' net foreign assets, M for money demand and NDA for the central banks' net domestic assets) and taking the derivative with respect to time gives the following: dNFA/dt = dM/dt - dNDA/dt. This indicates that the overall balance of payments is identically equal to the difference between the rate of change of money demand and the rate of change of central bank credit. Both monetary and real influences on the balance of payments are reflected in the above equation. The money demand is, in addition to domestic prices and interest rates, determined by real income while the central bank credit component of the money supply is determined by fiscal and budgetary factors. However, these real influences must operate through monetary factors. The monetary factors, therefore, have the primary role to play in determining the balance of payments, since they transmit disturbances from the monetary side as well as the real side.

Analysing the balance of payments as a monetary phenomenon has some interesting implications. The proponents assume the following: 1) the demand for money is a stable function of prices, real income, and interest rates, 2) that countries do not pursue sterilisation policy, either because they cannot sterilise over a long period or because they do not wish to do so, 3) in the long-run, output is at its full employment level, 4) domestic prices and interest rates cannot deviate from the world level for a long time, due to arbitrage, 5) the demand for and the supply of money are independent of one another, and the money multiplier is independent of the money market conditions, and conclude that:

(i) Under a fixed exchange rate regime, a country has no control over its money supply in the long-run, and cannot conduct any effective monetary policy. The pursuit of any domestic objective, such as price stability, by altering the domestic component of the monetary base (NDA) will be frustrated by an offsetting change in the international component (NFA) leaving the level of the monetary base and thus the money supply unchanged, (Kreinin and Officer 1978, p. 10). This implies that the

monetary base in the long-run is endogenous and cannot be controlled by the monetary authorities.

(ii) Assuming the absence of monetary contraction abroad, a chronic stock balance of payments deficit (a continuous decline in the foreign reserves of the monetary authorities) is a symptom of excessive expansion in the money supply over the money demand. Such a deficit can be primarily corrected by reducing the rate of expansion of the money supply, (see Humprey and Kelcher 1982, p.25).

5.3 The Reserve Flow Equation

In testing the propositions discussed above, which amounts to testing the validity of the monetary approach to the balance of payments theory, the proponents often derive and estimate an equation known as "the reserve flow equation". The reserve flow equation expresses the rate of change of the foreign component of the monetary base (the central bank's net foreign assets) as a function of the rate of change of the domestic component of the monetary base (the central bank's net domestic assets), rate of change in the money multiplier and the rate of change in the variables determining money demand. The derivation of the reserve flow equation is presented below; (see for example Watson 1988, Wilford and Wilford 1978, Wilford and Zecher 1979, for more detail).

$$M_d = L\,(P,\ Y,\ i\,) \tag{5.1}$$

$$M_s \equiv U \cdot (NFA + NDA\,) \equiv U \cdot H \tag{5.2}$$

$$M_d = M_s \tag{5.3}$$

$$\frac{\Delta M_d}{M_d} = \left[\frac{\Delta U}{U} + \frac{\Delta H}{H}\right] = \frac{\Delta U}{U} + \frac{\Delta NFA}{H} + \frac{\Delta NDA}{H} \tag{5.4}$$

$$\frac{\Delta NFA}{H} = \frac{\Delta Y}{Y} + \frac{\Delta P}{P} + \frac{\Delta i}{i} - \frac{\Delta U}{U} - \frac{\Delta NDA}{H} \tag{5.5}$$

$$\frac{\Delta NFA}{H} = a_0 + a_1\,\Delta \log Y + a_2\,\Delta \log P + a_3\,\Delta \log i - a_4\,\Delta \log U - a_5\,\frac{\Delta NDA}{H} \tag{5.6}$$

Equation (5.1) is the demand for nominal money balances, which is a positive function of prices (P), real domestic income (Y) and a negative function of the opportunity cost of holding money (i). Equation (5.2) is the money supply identity. The money stock is defined, in the spirit of the money multiplier approach to money stock determination, to be identically equal to the money multiplier (U) times the monetary base (H). Where the monetary base is further divided into domestic component (approximately equal to the sum of the central bank's net claims on the government, banks and the other non-bank public and private institutions (NDA)) and the foreign component (the net foreign assets of the central bank (NFA). Equation (5.3) expresses the money market equilibrium. Equation (5.4) is derived by combining (5.1) (5.2) and (5.3) above and expressing the variables in rates of change. Equation (5.5) is arrived at after isolating the growth rate of the money demand into its various components and solving the resultant for $\frac{\Delta NFA}{H}$. Equation (5.5) is the monetarists balance of payments equation popularly known as the reserve flow equation. The final estimated reserve flow equation is (5.6) which is identical to (5.5), where the rate of change of the variables determining the money demand are expressed as the first difference of their logarithm. The coefficient (a_5) is the offset coefficient.

Under the assumptions about domestic prices, income, and interest rate made in the previous section, all the variables determining the money demand and the money demand itself are beyond control of the monetary authorities in the long-run. Therefore, the only variable in equation (5.6) that can be changed by the monetary authorities is the domestic component of the monetary base (NDA). If the proposition that in the long-run the monetary authorities can only change the composition of the monetary base and not its level is true, the estimated coefficients of the central bank's net domestic assets (the offset coefficient (a_5)) and the money multiplier variable (a_4) in equation (5.6) would both be equal to minus one. A one naira increase in the central bank's net domestic assets will, ceteris paribus, lead to a one naira decline in the foreign component of the

monetary base. In the terminology of the literature, domestic monetary policy is said to be completely offset by the balance of payments.

Although the reserve flow equation is derived solely from the money market equilibrium expression, the advocates of the reserves flow equation visualise a general macroeconomic model with real, financial, and external sectors. In practice they attempt to reduce the general equilibrium model to a manageable size by singling out money as the centre of the analysis. They argue that since the balance of payments is essentially a monetary phenomenon, research efficiency dictates that a simple (Occam's razor) analysis of the balance of payments should concentrate on examining the money market directly, (Magee, 1976).

The "zero sterilisation" assumption is very important to the conclusions of this analysis. To assume otherwise, would have some theoretical and empirical implications. This point is taken up in detail in section (5.7) below.

5.4 The Capital Flow Equation

The reserve flow equation discussed above places the money market at the center of the analysis. It also (at least implicitly) assumes that the offset to monetary policy arises through both current and capital accounts of the balance of payments.

Another popular approach to examining the offset to domestic monetary policy is the capital flow approach, sometimes called the portfolio approach. Proponents of this approach argue that the offset to domestic monetary policy arises mainly through the capital account. The offset coefficient in the capital flow approach is interpreted as a measure of capital account sensitivity to change in the domestic component of the monetary base. Capital flow is viewed as the mechanism through which a domestic excess demand for money is removed. Money demand and supply are important in this approach, only to the extent that they determine the domestic interest rate, which further determines inflows and outflows of capital.

Central to the capital flow approach is the assumption that the flow of capital, in the form of financial assets, into and out of the country is relatively free of controls (capital is relatively mobile). Furthermore, foreign and domestic financial assets (bonds) are assumed to be perfect substitutes. Under these assumptions, an increase in the central bank's net domestic assets (NDA) (e.g through open market operations) would have the following effects: For a given demand for money, it would create an excess supply of money in the economy. To re-establish money market equilibrium, the domestic interest rate would have to fall. A decrease in the domestic interest rate vis-a-vis foreign interest rates would reduce the attractiveness of domestic assets and would encourage movement out of domestic currency denominated assets into foreign currency denominated assets, and thus capital would start moving out of the country. Investors wanting to invest abroad can only do so in foreign currencies, and therefore, in a fixed exchange rate regime, the necessary foreign currency is obtained from the monetary authorities in exchange for the domestic currency. If the fixed exchange rate is to be maintained, the above capital flow would translate one for one into a decline in the foreign currency reserves of the central bank. Under the assumptions given above, plus the implicit assumption of "no-sterilisation", the movement of capital out of the country, and thus the decline in the central bank's net foreign assets (NFA) will continue until the money market is brought back into equilibrium and a parity between domestic and foreign interest rates is re-established. At the end of the day (in the long-run), the increase in money supply, achieved through the increase in the domestic component of the monetary base, would have been completely offset by a decline in the foreign component of the monetary base (the central bank's net foreign assets) due to capital outflows. Money supply defined as the monetary base multiplied by the money multiplier remains at the initial level. For a given money multiplier, the domestic component of the monetary base has gone up, but the foreign component has gone down by exactly the same amount.

If the assumptions given above strictly hold, proponents of the approach conclude

that the offset to monetary policy would be complete and immediate. This implies that the monetary authorities would have no control over the monetary base and, therefore, over the domestic money stock. If, on the other hand, there is an imperfect substitutability of domestic and foreign assets, and an imperfect mobility of capital between countries, offset to domestic monetary policy would neither be immediate nor complete; and therefore, the monetary authorities may have some short run control. In addition, if the domestic credit creation activity affects private wealth, and the demand for money is a function of wealth, the capital account offset would not be complete even under perfect capital mobility and unlimited assets substitutability, (Cumby and Obstfeld, 1983 p. 24).

The capital flow equation, representing the relationship between the capital account balance and the change in the domestic component of the monetary base, and other variables, is normally derived from the financial assets market equilibrium conditions in the form of a portfolio equilibrium analysis. This method of deriving the capital flow equation, known as the reduced form approach, is mainly due to Kouri and Porter (1974). Applications include Obstfeld (1982), Laskar (1983), Kamas (1986) and Fry (1988) to mention a few. The main concern is with the mechanism through which equilibrium is obtained in the financial market of a small open economy.

Generally the relevance to most developing countries of the capital flows approach (especially to the developing countries of ECOWAS) is very limited. We have noticed above that one of the basic axioms of the capital flow analysis is the existence of a relatively free inflow and outflow of capital. With the exception of Liberia, all member countries of ECOWAS control or restrict the outflow of foreign exchange in connection with acquisition of foreign assets by nationals. Capital outflows require explicit approval by the monetary authorities and in some cases are completely prohibited. Approval by the authorities is usually given only when special circumstances warrant it; otherwise it is denied. However, in the WAMU countries, capital flow to France and the operation

account countries[2] are freely permitted.

With respect to capital inflow, a distinction is made between domestic residents borrowing from abroad and those resulting from foreign investors acquiring domestic real or financial assets. Borrowing from abroad by domestic residents requires approval in all member countries of the community, except in The Gambia and Liberia. In the WAMU countries of the community, special controls (in addition to any applicable exchange control requirements) are maintained over borrowing from abroad, inward foreign direct investment and all outward investment in foreign countries, as well as over the issuing, advertising, or offering for sale of foreign securities. Except for controls over foreign securities, these measures do not apply to member countries of ECOWAS and the operation account countries, (Mclenaghan et al, 1982).

5.5 Sterilisation

We have seen above that, according to the monetary approach theory, under certain assumptions, 1) a one shot expansion in the money supply, achieved through expansion in the domestic component of the monetary base would be completely offset by the balance of payments (change in the foreign component of the monetary base). In the long-run, an increase in the domestic component would be matched by a decline of equal magnitude in the foreign component. The monetary base and, for a given money multiplier, the money stock are endogenous and cannot be changed by the central bank at will. 2) An excess supply of money as a stock leads to a balance of payments deficit, which will eventually correct itself. One of the most important assumptions that lead to the above conclusions is that the monetary authorities do not carry out sterilisation of the deficit from affecting the domestic money supply.

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[2] *These are former French colonies that have special convertibility arrangement with France to guarantee 100 percent convertibility of their local currency. The countries, in turn, maintain an operation account with the French treasury where all of their foreign reserve must be kept.*

Sterilisation is said to occur when the monetary authorities of a country try to neutralise the effect of the balance of payments on the domestic money supply (foreign component of the monetary base on the domestic component). For example, if a country that operates a fixed exchange rate regime is running a balance of payments deficit, its domestic money stock will be falling as it is continuously being transferred to the foreign exchange authorities. A central bank can counter the falling money stock by expanding the domestic component of the monetary base. Although the most standard sterilisation procedure open to the central banks is the open market operations - sales or purchases of domestic assets (government bonds and securities) for the domestic base money - other procedures like the reserves requirements, special deposits, etc. can also be used.

Violation of the non-sterilisation assumptions would imply the following: 1) the offset to the domestic component of the monetary base will no longer be complete and as such the central bank can have some control over the monetary base and thus the money supply. 2) As discussed above, an essential feature of the monetary approach is that balance of payments deficits and surpluses are consequences of stock adjustments in the money market, and in the long-run, stock equilibrium in the money market ensures a balance of payments equilibrium. If the monetary authorities were to sterilise (neutralise) the inflows and outflows of money associated with balance of payments deficits and surpluses, the link between the money supply and the balance of payments will be severed. At the same time, the automatic self correcting mechanism of a payments deficit discussed earlier will be prevented from setting in. 3) An OLS estimation of the reserves flow and the capital flow equations will give biased estimates of the offset coefficient. This point is taken up in detail in a later section of this chapter.

The proponents of the monetary approach assert that monetary authorities cannot sterilise monetary inflows and outflows associated with the balance of payments surpluses and deficits for the following reasons: Firstly, the ability of the monetary authorities to carry out sterilisation for a long period of time is limited. Continuous

sterilisation of a deficit, for example, by buying up bonds in the open market will exacerbate the deficit. Purchases of bonds by the monetary authorities in the open market would lead to an increase in the demand for bonds. For a given supply of bonds, this would lead to an increase in the price of bonds, and therefore, a decrease in the interest rate. A decline in the domestic interest rate will encourage an outflow of capital, etc., adding to the balance of payments deficit and requiring a further sterilisation. A continuous sterilisation of surplus by selling domestic bonds would be brought to a halt by the exhaustion of the monetary authorities' stock of domestic bonds. Although the monetary authorities can get around this problem by continuously printing new bonds, there still exists the question of how to convince people to hold more of them. This can only be achieved if the the price of bonds were to come down continuously. A decrease in the price of bonds is tantamount to an increase in the domestic interest rate. A high domestic interest rate attracts more capital, further increasing the balance of payments surplus.

Under a fixed exchange rate regime, a balance of payments deficit also implies that the foreign exchange reserves of the monetary authorities are falling. This is the case because, foreign currency would have to be sold to prevent the incipient depreciation of the exchange rate, inherent in the increase in demand for foreign exchange. Since the foreign exchange reserves of a country is a component of the monetary base, its decline, ceteris paribus, is equivalent to a decline in the domestic monetary base and thus the money stock. Sterilisation, in this case, will take the form of an increase in the domestic component of the monetary base to maintain the monetary base, and thus the money stock at its initial level. Perpetuating the balance of payments deficit by sterilising its effect on the domestic money supply, and at the same time, maintaining the exchange rate fixed in the long-run is impossible. The stock of foreign reserves would be exhausted and either maintaining the fixed exchange would have to be abandoned, or the self-correcting mechanism inherent in a stock balance of payments deficit would be allowed

to set in (abandoning the sterilisation exercise).

Argy and Kouri (1974), who looked at the sterilisation issue in terms of the procedures and instruments for sterilisation open to the monetary authorities, have argued that monetary authorities may not be technically equipped with adequate monetary instruments to offset very large movements in the balance of payments. For example, the use of open market operations, one of the most efficient instruments available for carrying out the sterilisation exercise, can be restricted by the size and nature of the capital markets. To carry out sterilisation effectively, using open market operations, it is necessary for government bonds and securities to be bought and sold with ease, and as often as the need for sterilisation arises. This requires not only the existence of a capital market/stock exchange, which most developing countries do not have, but also a broad and effective one. The breadth and efficiency required for a successful sterilisation operation is hard to achieve even in the developed countries.

With regards to using the reserve requirement as an instrument for sterilisation, central banks may hesitate using it continuously because of its disruptive effect on commercial bank operations and profitability. If a country has a continuous balance of payments surplus, its money supply would also go up continuously. To sterilise the effect of the balance of payments surplus through changes in the reserve requirement would mean a continuous increase in the reserve requirement. As the reserve requirement goes up continuously, the amount legally available to banks for lending out as loans falls, and as a result their profits would fall continuously.

On the other side of the debate, some have argued that sterilisation, even if is not 100 percent, does happen. Thirlwall (1980), for example, argues that monetary authorities in the developed countries can and do carry out open market operations with the sole purpose of neutralising the effect of changes in international reserves on the domestic money supply.

The common practice among proponents and opponents of the monetary approach alike, is not to draw conclusions about sterilisation on theoretical grounds alone, but to carry out empirical tests to determine the existence and the degree of sterilisation carried out by a country, (see Cumby and Obstfeld, 1983, Argy and Kouri, 1974, Obstfeld 1982, Darby, Kamas 1986, among others). Many different testing procedures for determining the extent of sterilisation have been utilised in the literature. For example, Granger type causality tests can be employed to see if a causal relationship between the variables representing change in the domestic component and the foreign component of the monetary base is unidirectional (from the domestic component to the foreign component only or vice versa) or bidirectional. Causation flowing from the foreign to the domestic component indicates the existence of sterilisation. See chapter 3 for a discussion on the Granger-causality test.

A popular procedure for investigating the existence of sterilisation, which gives the total percentage of the effect of balance of payments on domestic money supply sterilised, requires estimating a function commonly known as the "Monetary Policy/Money Supply Reaction Function". The money supply reaction function provides a formal statement of the behaviour of the monetary authorities with regard to money supply. It is usually specified as an equation expressing the money supply or change in the domestic component of the monetary base (ΔNDA) as a function of change in the foreign component of the monetary base (ΔNFA), and other exogenous variables that determine a country's money supply. The estimated coefficient of the change in the foreign component of the monetary base (ΔNFA) gives the sterilisation coefficient.

The derivation of the most commonly estimated monetary policy reaction function is presented below; (see Porzecanski 1979, Darby 1983, for more details).

$$\Delta \log M^s = \alpha \frac{\Delta NFA}{H} + \beta X \tag{5.7}$$

$$\Delta \log M^s = \Delta \log H = \frac{\Delta NFA}{H} + \frac{\Delta NDA}{H} \tag{5.8}$$

$$\frac{\Delta NDA}{H} = (\alpha - 1)\frac{\Delta NFA}{H} + \beta X \tag{5.9}$$

Equation (5.7) is the monetary policy reaction function, stating that change in the money supply is a function of contemporaneous balance of payments, ($\frac{\Delta NFA}{H}$) and a vector of other variables that determine a country's money supply (X). The vector (X) for example, can contain the growth rates of income and inflation, or even the previous period's balance of payments balance. The variable (α) is called the sterilisation coefficient. The value of α is expected to lie between zero and one. An α value of one means that no sterilisation is taking place at all. Changes in the foreign component of the monetary base are fully reflected in the money stock. If the value of α turns out to be zero, it means a complete sterilisation exercise is practiced. This means the relationship between money supply and the balance of payments is completely severed, and therefore changes in the balance of payments will not affect the money supply.

Money supply, as discussed earlier, is defined as the sum of net foreign assets and the net domestic assets of the central bank (H) multiplied by the money multiplier. If the assumption of pegged exchange rates is to be maintained, the foreign asset component of the money supply is completely beyond the control of the monetary authorities. It increases when the country's balance of payments is in surplus and decreases when it is in deficit. When the country's balance of payments is in surplus, the demand for domestic currency is going up, and to keep the price of domestic currency (exchange rate) fixed, the monetary authorities would have to sell domestic currency in exchange for foreign currency, thus increasing the foreign currency reserve of the monetary authorities. The opposite would be the case if a country's balance of payments is in deficit. The monetary authorities can only change the money supply through the domestic component of the monetary base. It is, therefore, most appropriate to express the monetary policy reaction function in terms of a variable representing change in the domestic component of the monetary base. Equation (5.8), assuming a constant money multiplier, expresses the change in the logarithm of the money supply as identically equal to the change in the logarithm of the monetary base (H). Isolating (H) into its two components (the domestic

component (NDA) and the foreign component (NFA)), the change in the logarithm of the money supply is expressed as approximately equal to the sum of the change in the domestic component (ΔNDA) and the foreign component (ΔNFA) divided by the monetary base (H). Substituting (5.8) into (5.7), collecting like terms, and solving the result for the variable representing change in the domestic component of the monetary base ($\frac{\Delta NDA}{H}$) gives equation (5.9). Equation (5.9) is the money supply reaction function, expressed in terms of the change in the domestic component of the monetary base.

Normally some form of equation (5.9) is estimated and the coefficient of the scaled contemporaneous balance of payments is used as a measure of sterilisation. This coefficient is the sterilisation coefficient when the money supply is expressed in terms of change in the domestic component of the monetary base. The estimated value of this coefficient ($\alpha - 1$) is expected to be between minus one and zero. A minus one value (an α value of zero) is taken to indicate that the offset to the domestic component of the monetary base is completely sterilised. On the other hand an estimated coefficient of zero (an α value of one) is taken as an indication that no sterilisation exercise is taking place at all.

5.6 Relevance of the Monetary Approach to the Balance of Payments

One way of judging a theory is to look at the validity of its assumptions. The monetary approach to the balance of payments theory, in its extreme form, as stated earlier, assumes the following:

(1) The demand for money is a stable positive function of domestic prices, real income, and a negative function of the interest rate (the opportunity cost of holding money).

(2) Wage-price flexibility fixes output at the full employment level, at least in the long-run, such that output can only be increased through supply variables.

(3) Perfect substitution across countries in both products and capital markets ensures "one-price" for each commodity and one interest rate.

(4) Countries do not pursue any sterilisation policies, either because they cannot or they do not wish to do so.

Stability of the demand for money function is more of an empirical issue than a theoretical one. In the case of Nigeria, it was shown in the last chapter that it is possible to find a stable demand for money function, related to the determinants in the postulated way.

The full employment of resources assumption is not very realistic if, for example, one looks at the countries of ECOWAS. Unemployment and underemployment, especially that of labour, are common features of these countries. This condition is partly due to the seasonal nature of their economic activities (agriculture oriented). Agricultural labourers in any given year are fully engaged for not more than six months (rainy season and the harvesting periods). Although supply factors like the weather and other natural phenomenon are important in determining output of the ECOWAS countries, demand factors also play a very important part. For example, cocoa production in Nigeria has gone up quite considerably since 1986, due to the increase in foreign demand for Nigerian cocoa, partly brought about by the devaluation of the Nigerian currency by about 500 percent.

Perfect substitution across countries, in both products and capital goods, ensuring one price and one interest rate, is in reality not tenable in the developing countries of ECOWAS. Neither goods nor capital are perfectly, or even reasonably, mobile in these countries, such that arbitrage can establish one price and one interest rate. For example, as has been discussed in chapter 1, movement of capital in and out of Nigeria is characterised by a stringent set of controls. Moreover, the interest rate in Nigeria and the other ECOWAS countries are directly controlled by the authorities, rather than being determined by market forces.

With regard to the "non-sterilisation" assumptions, developing countries might be constrained in their efforts to sterilise, by lack of appropriate tools. For example, open market operations, one of the most often utilised tools for the purpose of sterilisation, has never been used for any purpose in the countries of ECOWAS. Other instruments (reserve requirements, etc.) that can be used to expand or contract the money supply for the purpose of sterilisation are very restricted in their ability to achieve the ends. As discussed in section (5.5) of this chapter, the question of validity of the "non-sterilisation assumption is an empirical issue. Procedures for the empirical test of this assumption have also been discussed in the same section; the outcome of the test using the Nigerian data will be reported in the next chapter.

Proponents of the monetary approach to the balance of payments theory, however, have argued that the approach is most suitable for analysing the developing country balance of payments, (see Wilford, 1978). Data on monetary variables in developing countries are the most reliable and most readily available, while data on trade of goods and services are very difficult to come by and are highly unreliable. For example, it is virtually impossible to get accurate trade data in most developing countries due to the prevalence of underground trading activities, etc. This problem is compounded in the case of the African countries, by the fact that the countries are all characterised by artificially demarcated land borders, which cannot be effectively policed. Given these special features of the developing countries, the monetary approach, which focuses directly on the money market and the relevant monetary aggregates, gives a less complicated and more reliable empirical framework for policy evaluations and policy prescriptions in these countries.

5.7 Critique of the Monetary Approach to the Balance of Payments

It was stated earlier in this chapter that the essential element of the monetary approach to the balance of payments theory is the assertion that there is a direct link between the balance of payments and the total money supply - the balance of payments

affects and is in turn affected by the money supply. Specifically, the balance of payments deficits and surpluses are seen as a consequence of a stock adjustment in the money market. An excess money supply leads to a balance of payments deficit, while an excess money demand leads to a surplus. To test this assertion, the proponents of the monetary approach estimate the reserve flow equation by OLS estimation techniques.

The monetary approach to the balance of payments has been criticised on both theoretical and empirical grounds. Currie (1976), for example, argued that the monetary approach is able to establish a direct relationship between the money supply and the balance of payments because it ignores the government budget constraint. A disequilibrium in the money market does not necessarily have to be reflected in a balance of payments deficit or surplus, because it could be offset instead by a deficit or surplus on the government's budget. When the balance of payments in a fixed exchange rate regime is in surplus/deficit, the government can acquire/lose foreign reserves continuously without disturbing the private sector equilibrium money holding, provided that it runs a budget surplus/deficit equal to the balance of payments surplus/deficit. Simply, it is believed that governments can sterilise the effects of payments surpluses and deficits by a deliberate policy of running a budget surplus/deficit. However, the non-viability of a continuous sterilisation of the balance of payments deficit is acknowledged by Curry (1976) in the quotation given below.

> *"There is of course, a limit to the depletion of reserves, and a rather more elastic limit to official borrowing. However, we do not require monetary theory of balance of payments, or indeed any theory, to realise that a continuous depletion of reserves is eventually incompatible with the maintenance of a fixed exchange rate system. The point is that, if governments choose to run a balance of payments deficit or surplus for extended periods, there need be no offsetting endogenous forces"*, (Currie, 1976 p. 510, Footnote no. 3).

It has been mentioned earlier that the balance of payments deficit, caused by an excess supply of money, is self correcting if the monetary authorities do not carry out sterilisation.[3] The continuous existence of a stock balance of payments deficit is possible

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[3] *see section on sterilisation in this chapter for definition and complete discussion of the term.*

only if an excess supply of money is somehow maintained. Thirlwall (1980) argues that the observed excess supply of money is not necessarily the cause of the balance of payments deficit, but rather the outcome. Following the absorption approach, he shows that it is possible for planned expenditure and income/output to be in balance, but yet the balance of payments to be in deficit. This happens when domestic producers cannot sell all goods produced in any given year, after satisfying domestic demand. The end result is to reduce production (income/output) next period. A fall in income, following the transactions motive for holding money, would lead to a decrease in the money demand. For a given money supply, a fall in the demand for money would create an excess supply of money.

Regarding the assumptions behind the monetary approach, Thirlwall(1980) believes that it is not realistic to assume exogeneity of income, prices and interest rates. In the real world, one would expect these variables, especially in the long-run, to vary significantly with variations in the quantity of money. This, he further argued, would rule out the conclusions of the monetary approach that there is a one to one relationship between changes in the domestic component and the foreign components of the monetary base. As a result, it would no longer be possible to predict movements in the balance of payments from changes in the money supply alone.

On empirical grounds, it has been argued that estimating the popular monetary specification of the balance of payments (the reserve flow equation) using the OLS technique gives a result biased towards accepting the monetary approach's conclusions, (see Kamas (1986), Frenkel et al (1980), Magee (1976) among many others).

The reserve flow equation (equation (5.6)), is derived from solving the money market equilibrium condition, equation (5.10) below for the rate of change of the foreign component of the monetary base variable ($\frac{\Delta NFA}{H}$).

$$\Delta \log U + \frac{\Delta NDA}{H} + \frac{\Delta NFA}{H} = m_1 \Delta \log P + m_2 \Delta \log Y + m_3 \Delta \log i \qquad (5.10)$$

The right hand side of (5.10) is an ordinary money demand equation, expressed in logarithmic first differences, while the left hand side is the money supply identity, also expressed in logarithmic first differences. Solving (5.10) for $(\frac{\Delta NDA}{H})$ requires bringing $(\Delta \log U)$ and $(\frac{\Delta NDA}{H})$ to the right hand side, where both terms become negative. If the money demand equation (right hand side of equation (5.10)) is correctly specified, and fits the data exactly, then it would clearly continue to fit exactly, even though the terms $(\Delta \log U)$ and $(\frac{\Delta NDA}{H})$ were brought over to the right hand side, as is the case with the reserve flow equation. Under this condition, the estimated coefficients of the money demand equation in the reserve flow equation would be the same as the true coefficients, while those of $(\Delta \log U)$ and $(\frac{\Delta NDA}{H})$ would be exactly minus one, as hypothesised by the monetary approach to balance of payments theory. An estimated offset coefficient different from minus one (not supportive of the monetary approach theory) simply means that the money demand function is either not correctly specified, unstable or both, (Frenkel et al (1980)).

According to Taylor (1990), the reserve flow equation is in fact nothing more than the money stock identity in disguise. The disguise being the money market equilibrium assumption which allowed the money demand function to be used to replace the money stock variable. He argued that the reserve flow equation will always tend to produce results supportive of the monetary approach, irrespective of whether the implicit money demand function is correctly specified, stable or not. How close estimates of the reserve flow equation to what the monetary approach suggests it should be, would depend on how small a term called the "approximation error" is. The approximation error is the difference between growth of the actual money stock and the estimated growth of money demand. The smaller the approximation error, the more supportive are the coefficient estimates of the reserve flow equation to the monetary approach theory.

The money stock equation utilised in the derivation of the reserve flow equation is restated below, where all variables are as defined earlier.

$$M \equiv U \cdot (NFA + NDA) \equiv U \cdot H \tag{5.2}$$

Taking the logarithm of equation (5.2) and expressing it in first difference renders equation (5.11) below:

$$\Delta LogM \equiv \Delta LogU + \frac{\Delta NFA}{(NFA + NDA)} + \frac{\Delta NDA}{(NFA + NDA)} \tag{5.11}$$

Simple rearrangement of (5.11) produces (5.12) which is still a perfect identity:

$$\frac{\Delta NFA}{(NFA + NDA)} \equiv \Delta LogM - \Delta LogU - \frac{\Delta NDA}{(NFA + NDA)} \tag{5.12}$$

Equation (5.12) is the same reserve flow equation (5.6) where $\Delta LogM$ is replaced with the term $(a_0 + a_1 \Delta LogY + a_2 \Delta LogP + a_3 \Delta Logi)$. The difference between these two terms $[E = \Delta LogM - (a_0 + a_1 \Delta LogY + a_2 \Delta LogP + a_3 \Delta Logi)]$ is what Taylor (1990) calls the approximation error. The closer is the approximation error to zero, the closer will be the reserve flow equation (5.6) to the perfect identity (5.12) and the closer will be the estimated coefficients of the money multiplier and the domestic component of the monetary base to minus one. If 'E' is equal to zero, these coefficients will both be exactly minus one as predicted by the monetary approach theory.

This argument reinforces the one presented by Frenkel et al (1980). The estimated offset coefficient from the reserve flow equation, instead of being an estimate of the reduced-form effect of the growth of the domestic component of the monetary base on the growth of the foreign reserve, is actually an estimate of minus unity. Estimates of the reserve flow equation, which are favourable to the monetary approach theory, are nothing more than a test of the size of the approximation error.

If income, prices, and interest rates are affected by the money supply, and not as assumed by the monetary approach theory, estimating the reserve flow equation, using OLS techniques, would lead to simultaneity bias. An increase in the money supply, for example, brought about by an exogenous increase in foreign reserves, would lead to an

increase in income, prices and a decrease in interest rates to re-establish the money market equilibrium. On the demand side, an increase in income and prices, and a decrease in interest rates would lead to an increase in money demand, which further leads to an increase in foreign reserves. The relationship between these variables and the foreign reserve are the same in the two cases. Therefore, it is impossible to tell whether the estimated parameters of the reserve flow equation are reflecting the effect of money supply or that of money demand. Furthermore, in both cases, the relationship is as predicted by the monetary approach theory, which implies that the above simultaneity bias would work to reinforce the conclusion of the monetary approach to the balance of payments theory, (Magee 1976).

Magee (1976) has further argued that existence of a partial sterilisation and an omission of a relevant variable from the reserve flow equation have opposite effects on the estimated value of the offset coefficient. If a relevant variable (for example, the exchange rate) were omitted from the reserve flow equation, OLS estimation of the offset coefficient can be significantly less than one. A percentage of any change in the domestic component of the monetary base (central bank's net domestic assets) would be absorbed by the excluded variable so that the foreign component of the monetary base (the central bank's net foreign assets) would not change by as much as the initial change in the central bank's net domestic assets, (see also Laskar, 1983).

On the other hand, if an economy is truly characterised by a complete offset (an offset coefficient of minus one), a partial sterilisation would lead to an OLS estimate of the offset coefficient of greater than minus one (in absolute value). Suppose, there is an exogenous increase in the money demand, according to the monetary approach, it will lead to an inflow of reserves to meet this demand. If the government partially offsets the effect of this inflow on the money supply by reducing the domestic component of the monetary base by some fraction "S", then the domestic money demand will be unsatisfied by up to this amount. In the second round, reserves commensurate with the fraction "S"

will flow in. If the authorities further reduce the domestic component by a fraction "S" or a fraction "S^2" of the original level, and so on, the end result is an OLS estimate of the coefficient of the domestic component of the monetary base of "1/(1-S)", which is greater than one in absolute value. The existence of partial sterilisation, therefore, biases the OLS estimate of the offset coefficient upward, while an omission of a relevant variable (e.g the exchange rate), biases it downward. The result from OLS estimation of the offset coefficient, using the reserve flow equation, is therefore, not a reliable test for the degree of the balance of payments offset to a country's monetary policy.

Lastly, the monetary approach theory has been criticised on the grounds that it emphasizes a long-run equilibrium scenario, while totally neglecting the short-run adjustment path. The short-run adjustment path and the duration of this adjustment to the long-run equilibrium is important because of the following: 1) The social cost of adjustment depends on the time it takes to reach the long-run equilibrium. 2) Policy makers work with a fairly short-run "political" horizon and therefore, an understanding of the adjustment path from the short-run to the long-run equilibrium situation is very important.

5.8 Synthesis of the Keynesian and the Monetary Approaches to the Balance of Payments

Most of the short-comings of the reserve flow equation discussed above can be overcome by the use of a general model encompassing real, financial, and external sectors of the economy. For example, the criticism of the reserve flow equation as being an estimate of minus one, rather than that of balance of payments offset to domestic monetary policy, arose because the equation was derived from the money market condition alone, neglecting all other sectors of the economy. By using a more general model, it is also possible to investigate the offset not only in the long-run, but also in the short-run, where domestic prices, income, and interests are allowed to change.

Furthermore, it is now widely accepted that the opposing Keynesian and Monetary approaches to the balance of payments theory can also be reconciled in a more general model (Magee, 1976). Frenkel et al (1980) carried out the exercise of reconciling the two approaches theoretically. Before going into the details it is necessary to give a brief summary of the Keynesian and the monetary approach to the balance of payments theory.

The Monetary approach to the balance of payments theory, discussed in detail in earlier sections, can be summarised by the following equations:

$$M^d = L\,(P,\ Y,\ i\,) \tag{5.1}$$

$$M^s \equiv U\cdot(NDA + NFA\,) \tag{5.2}$$

$$\Delta NFA = \frac{1}{\Delta U}\cdot L\,(P,\ Y,\ i\,) - \Delta NDA \tag{5.13}$$

Equation (5.1) and (5.2) are the demand and supply of money equations described earlier. Equation (5.13) is the monetary approach to the balance of payments equation derived by expressing (5.1) and (5.2) in first differences, setting them equal to each other, and solving for the ΔNFA variable.

The Keynesian balance of payments theory can also be summarised by the following equations, (Frenkel et al 1980, p 584).

$$C = c\,(Y,\ e/P\,) \tag{5.14}$$

$$K = K\,(i) \tag{5.15}$$

$$\Delta NFA \equiv P\cdot C + K \tag{5.16}$$

$$\Delta NFA = P\cdot c\,(Y,\ e/P\,) + K\,(i) \tag{5.17}$$

Equation (5.14) is the trade balance, or the current account balance defined to be a negative function of domestic real income (Y) and a positive function of the relative price of foreign to home goods (e/P). An increase in domestic income is in the familiar way expected to increase domestic imports, and thus worsen the current account. An increase in the relative price of foreign to home goods discourages imports and improves the current account balance. Equation (5.15) is the capital account balance, expected to be a positive function of the domestic interest rate (i). Equation (5.16) is the balance of payments identity, where the balance of payments is defined to be identically equal to the

sum of current and capital account balances. Equation (5.17) is the Keynesian balance of payments equation, derived from substituting (5.14) and (5.15) into (5.16).

These two approaches to the balance of payments theory diametrically differ in their assumptions, conclusions, and policy prescriptions. The monetary approach, emphasising a long-run perspective, argues that the balance of payments is a monetary phenomenon, and therefore, any balance of payments problem reflects a problem in the money market. It also assumes that countries cannot sterilise surpluses or deficits of the balance of payments and concludes that in the long-run a small open economy, under a fixed exchange rate regime, would have no control over its domestic money supply. Increases in the money supply, achieved through expansion in the domestic component of the monetary base, will leak out of the country. The simple Keynesian approach, on the other hand, emphasises a short-run perspective and implicitly assumes complete sterilisation. Its main conclusion is that the balance of payments is affected by real non-monetary variables and balance of payments problems (deficits and surpluses) can be corrected through non-monetary means.

The two approaches also give different predictions of the effect of changes in certain variables on the balance of payments. The monetary approach predicts that an increase in income and prices would lead to an improvement in the balance of payments. The effect of these variables on the balance of payments arises indirectly through money demand. An increase in income and prices would increase the demand for money. This would reduce expenditures not only on domestic goods, but on foreign goods as well, and thus affect the balance of payments. Contrary to the monetary approach predictions, the simple Keynesian approach concludes that an increase in income would increase expenditures on both domestic and foreign goods, and as a result leads to a deterioration of the balance of payments. Likewise an increase in the domestic prices because it reduces competitiveness and reduces exports demand, leads to a deterioration of the balance of payments.

The two approaches however, have the following in common: both are partial approaches, in the sense that the Monetary approach uses only the money market condition to derive the balance of payments equation, while the Keynesian approach concentrates on the current and capital accounts. Both approaches also treat real domestic income (Y), domestic prices (P) and interest rate (i) as independent exogenous variables. The Keynesian approach assumes implicitly that these variables are determined elsewhere in a more complete model. The Monetary approach, on the other hand, assumes that in the long-run real domestic income (Y) is supply determined, while (P) and (i) may be taken to be fixed abroad for a small open economy on fixed exchange rates.

Frenkel et al (1980) have argued that neither approach is entirely wrong theoretically. However, both have the weakness of being partial approaches. This weakness can be corrected by using a more general model where both the Keynesian and monetary approaches can be accommodated. The general model they use to show the above contention is made up of the following equations:

$$M^d = L(P,\ Y,\ i) \tag{5.1}$$

$$M^s \equiv U \cdot (NDA + NFA) \tag{5.2}$$

$$\Delta NFA = \frac{1}{\Delta U} \cdot L(P,\ Y,\ i) - \Delta NDA \tag{5.13}$$

$$\Delta NFA = Pc(Y,\ e/P) + K(i) \tag{5.17}$$

$$Y = J(Y,\ i) + G + c(Y,\ e/P) \tag{5.18}$$

$$Y = Y(P) \tag{5.19}$$

Equations (5.1) to (5.17) are as described earlier. Equation (5.18) defines the domestic output as the sum of private expenditure (J), government expenditure (G), and net exports (C). Equation (5.19) is the aggregate supply function. The endogenous variables of the model are Y, i, P, NFA, and M, while the exogenous control variables are G, NDA, and e.

$$P = P(Y) \tag{5.20}$$

$$i = i(Y,\ G,\ e) \tag{5.21}$$

$$NFA = k_1 Y + k_2 G + k_3 e + NFA_{t-1} \tag{5.22}$$

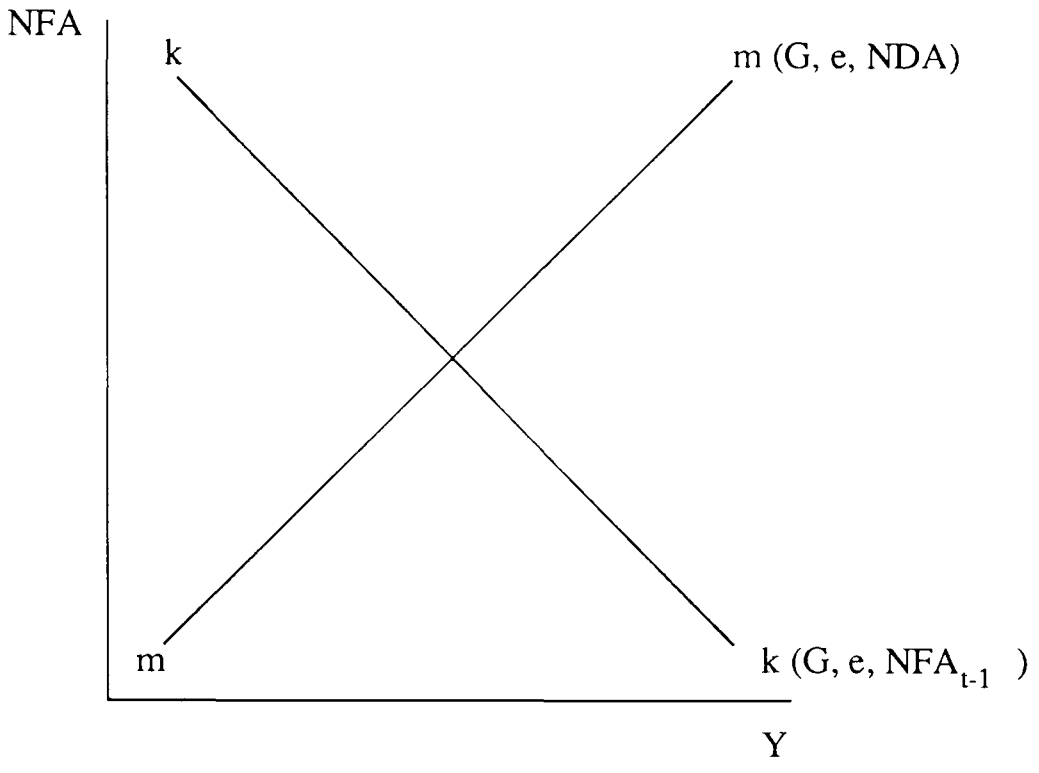
$$NFA = m_1 Y + m_2 G + m_3 e - NDA \tag{5.23}$$

To focus on output and balance of payments, (5.19) was first solved for (P), to give equation (5.20). Further, (5.20) was substituted into (5.18) and solved for (i), to yield equation (5.21). Substituting (5.20) and (5.21) into (5.13) and (5.17) gave what Frenkel et al (1980) called the modified Keynesian balance of payments equation (5.22) and the modified Monetary balance of payments equation (5.23). The variables (k_1) and (k_2) are expected to be negative, while (k_3) is expected to be positive. On the other hand, (m_1) is expected to carry a positive sign while (m_2) and (m_3) are expected to carry negative signs. Plotting on NFA and Y plane, equation (5.22) gives a negatively sloping curve, while (5.23) gives a positively sloping curve, (see figure 1 below). This is the case because, as stated above, the relationship between NFA and Y in the modified Keynesian equation (5.22) is negative, but in the modified monetary equation (5.23) it is positive. Using this diagram (figure 1) they show how potentially misleading it is to regress ΔNFA on Y to see if the two are positively related, as predicted by the partial monetary approach, or negatively related as predicted by the partial Keynesian approach. In this more general model, NFA (or ΔNFA) and Y can move, in the short-run, in the same or opposite direction depending on what triggers the initial shock.

Looking at (figure 1) below, when (NDA) changes the modified monetary schedule shifts, so that (Y) and (NFA) move in opposite directions. When (G) changes, both monetary and Keynesian schedules shift in the same direction. (Y) and (NFA), in this case may, move in the same direction, or in the opposite direction. When (e) changes, both schedules shift in the same direction, but it can be shown algebraically that (Y) and (NFA) move in the same direction, (see Frenkel et al, 1980 p. 589).

Following the suggestion of Magee (1976) about synthesising the Keynesian and the Monetary approaches to the balance of payments, which is carried out analytically by Frenkel et al (1980), Kamas (1986) tried to estimate by way of a general equilibrium macro-model, the short-run balance of payments offset to monetary policy for Mexico

Figure 1



and Venezuela, using quarterly data.

The adequacy and the robustness of Kamas' (1986) model and estimates are however questionable. The only diagnostic statistics reported are the standard errors of the regression and the adjusted R-squared. For the 2SLS results, only the standard errors are reported. No tests for the serial correlation of the error terms are conducted. Although the Durbin-Watson test (dw) would not be valid in cases where lagged dependent variables are used as explanatory variables, alternative tests like the Durbin h could be used. An even stronger test for serial correlation, which can test for higher order serial correlation is the Langrange multiplier test. Further, no test for normality of the residuals has been carried out. A split sample chow-test or some other kind of test should have been used for the case of Mexico to see if periods before and after the devaluation of its currency in 1976 can be represented by the same model.

5.9 Summary and Conclusion

In this chapter the theory behind a coefficient used for measuring the degree to which a country's domestic component of the monetary base is offset by the foreign

component (popularly known as the offset coefficient) is discussed. Knowledge of the offset coefficient is important, because it is one of the main determinants of a central bank's ability to change the monetary base for monetary policy purposes. For example, if the offset to the domestic component of the monetary base is complete, the monetary base is endogenous and the central bank cannot change it in the long-run. The offset coefficient is usually derived and estimated in the context of the monetary approach to the balance of payments theory.

The starting point of the monetary approach to the balance of payments theory is the contention that the balance of payments is essentially a monetary phenomenon, and that balance of payments problems are a reflection of disequilibria in the money market. A balance of payments deficit, for example, is seen as only arising, and can only be sustained if actual cash balances exceeds desired cash balances (excess supply of money). According to this theory, analysis relating to balance of payments should concentrate on the money market alone. Supporters of this approach have argued that to say that the balance of payments is essentially a monetary phenomenon does not mean that it is not affected by real variables, but the effect of the real variables would have to come through the monetary variables, specifically through the money demand.

Proponents of the monetary approach, under certain assumptions[4] argue that a small open economy operating a fixed exchange rate regime cannot change the monetary base in the long-run. Any change in the domestic component of the monetary base (a component of the money supply used as a control variable) carried out with the intention of altering the quantity of money stock in the economy would be offset by an equal but opposite change in the foreign component of the monetary base, such that the monetary base and the quantity of money stock remain unaltered.

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[4] *countries do not or cannot sterilise balance of payments surpluses and deficits, countries cannot alter domestic prices and interest rates because they are price takers, countries cannot change their real income because it is determined by supply factors, and that their demand for and supply of money are independent of one another*

To test the above proposition, which also amounts to testing the monetary approach theory, two equations, known as the reserves flow and capital flow equations in the literature, are formulated and estimated. The reserve flow equation expresses the rate of change of the foreign component of the monetary base (net foreign assets of the central bank) as a function of the rate of change of the domestic component of the monetary base (net domestic assets of the central bank), rate of change of the money multiplier, and the rate of change of the variables determining the demand for money. The implicit assumption is that the offset to domestic monetary policy (changes in the net domestic assets of the central bank) arises through the balance of payments balance (synonymous with changes in the central bank's net foreign assets), and thus justifies the use of the net foreign assets as the dependent variable of the equation. In contrast, the adherents of the capital flow equation argue that offset to domestic monetary policy does not arise through the balance of payments as a whole, but rather through the private capital balance. The capital flow equation therefore, uses changes in the net private capital as its dependent variable, while change in the domestic component of the monetary base (the central bank's net domestic assets), the level of the current account balance and few other variables are used as the independent variables. Since the capital flow equation assumes a fairly free flow of private capital between countries, its relevance to most developing countries, especially the countries of ECOWAS where strict capital controls are practiced, is very limited. In both reserve flow and capital flow equations, the coefficient of the central bank's net domestic assets variable is taken to represent the offset coefficient, measuring the degree of offset to the domestic component of the monetary base. An estimated offset coefficient value of minus one is taken to support the conclusion of the monetary approach theory that the balance of payments is essentially a monetary phenomenon, and that in the long-run small open countries would have no control over their monetary base and thus the domestic money supply.

The monetary approach theory and practice has been argued to be more suitable

than alternative theories for the purpose of analysing the developing countries' balance of payments. This is the case because it concentrates on the money market alone, is less complicated, and the data on monetary variables are most reliable and most readily available in the developing countries. This means that it is easier to carry out empirical studies for the purpose of policy prescriptions. The above proposition is quite reasonable when examining the developing countries of ECOWAS. Data on trade in the sub-region are very scanty and most often not very reliable because of the level of underground trade, encouraged by artificially demarcated borders between countries.

The monetary approach and its methods of estimating offset to domestic monetary policy has been criticised on many grounds. It has been argued that disequilibrium in the money market (excess supply of money) is an outcome rather than a cause of balance of payments deficits. The non-sterilisation assumption of the monetary approach theory has been criticised on the grounds that it is unrealistic. Countries in general do expand or contract the money supply in reaction to a change in the balance of payments position. Furthermore, the assumptions that domestic real income, domestic prices, and domestic interest rates do not change in the long-run has been attacked as too restrictive. The most damaging of the criticisms is that the estimated coefficient of the rate of change in the domestic component of the monetary base, using the reserve flow equation, does not represent an estimate of the offset coefficient, but rather that of minus one. This is because the equation is derived from the money market equilibrium condition alone, neglecting other sectors of the economy. In addition, if some sterilisations are carried out by the monetary authorities, estimates of the offset coefficient, using either of the monetary approach equations, would be biased upward.

By using a more general model, encompassing not only the financial sector, but also the real sector and the external sector of the economy, it is possible to overcome some of the short-comings of the monetary approach method of measuring the offset coefficient.

In the next chapter, the offset coefficient from a general equilibrium model, which

gives the offset in the short-run, will be derived and estimated using the Nigerian data. For the purpose of making comparison, the reserve flow equation, derived and discussed earlier in this chapter, will also be estimated. Furthermore, a monetary policy reaction function, also derived and discussed in this chapter, will be estimated with a view to investigating the degree of sterilisation carried out.

Chapter 6

Derivation and Estimation of the Short-Run Offset to the Domestic Component of the Monetary Base

6.1 Introduction

In the previous chapter a detailed discussion of the theory and practice of estimating the degree to which any change in the domestic component of the monetary base is offset by the foreign component was carried out, in the context of the monetary approach theory. It was shown that the monetary approach method of formulating and estimating the degree of this offset (the offset coefficient) is unsatisfactory because of the partial nature of the model used. It has been suggested that by using a more general model, some of the short-comings of the monetary approach could be removed.

In this chapter, an attempt is made to estimate the offset coefficient for Nigeria, covering the period from 1960 to 1989. This is carried out first of all by estimating the monetary approach equation - the reserve flow equation, and then a quasi reduced form-behavioural equation derived from a IS-LM-BP type general model. Unlike the reserve flow equation, the general model gives the offset coefficient in the short-run, where domestic income, domestic prices, and domestic interest rates are allowed to change.

In addition to the two balance of payments equations, a domestic monetary policy reaction function, also formulated and discussed in the last chapter, will be estimated with the aim of investigating the possible existence and the extent of any sterilisation exercise undertaken from 1960 to 1989. A complete sterilisation implies the following: 1) the foreign component of the monetary base is no longer allowed to offset changes in the domestic component. 2) A balance of payments problem may no longer be a monetary phenomenon, (see chapter 5 for a detailed discussion of these points). 3) A single equation estimation of an offset coefficient, using either the reserve flow equation,

or the equation derived from a general equilibrium model is likely to lead to a simultaneity bias. In both equations, one of the independent variables (change in the domestic component of the monetary base) will tend to depend on the dependent variable (change in the foreign component of the monetary base).

Furthermore, an exchange rate change reaction function will be formulated and estimated. The exchange rate change reaction function will measure the degree to which Nigeria has changed its exchange rate in reaction to a change in the central bank's net foreign assets (its balance of payments position). If a country changes its exchange rate in response to the pressure from a balance of payments deficit, or surplus, the relationship between the balance of payments and the money market, postulated by the monetary approach to the balance of payments theory, will be weakened, or in the extreme case, completely severed.

The rest of the chapter is organised as follows: In section (6.2), the general model is presented, and the equation used for estimating the short-run offset coefficient is derived and discussed. In addition, the reserve flow equation and the monetary policy reaction function, derived in the last chapter, are also presented and discussed in an empirical context. Also in this section, an exchange rate change reaction function is formulated and its components examined. A discussion of the econometric methodology and the estimation techniques employed to estimate the relevant equations is taken up in section (6.3). Section (6.4) presents the estimation results and the discussion of these results. Finally, section (6.5) presents the summary and conclusions of the chapter.

6.2 The General Model

The general model, which is made up of the real, financial, and the external sectors of the economy is outlined below:

$$M^d = L\,(Y,\ P,\ i,\ W) \tag{6.1}$$

$$M^s \equiv U\cdot(NFA + NDA) = U\cdot H \tag{6.2}$$

$$M^d = M^s \tag{6.3}$$

$$C = P\,c\,(Y,\ Y^{*},\ P,\ PI,\ PX,\ E\,P^{*)} \tag{6.4}$$

$$K = K\,(i,\ i^{*}\Delta E^{e}) \tag{6.5}$$

$$\Delta NFA = C + K \tag{6.6}$$

$$Y = J\,(Y) + I\,(r) + G + c\,(Y,\ Y^{*},\ P,\ PI,\ PX,\ EP^{*}) \tag{6.7}$$

$$Y = f\,(P) \tag{6.8}$$

$$r = i - \pi^{e} \tag{6.9}$$

$$W = M + B \tag{6.10}$$

Equations (6.1) and (6.2) are similar to equations (5.1) and (5.2) discussed in chapter 5. Equation (6.1) is the demand for nominal money balances. It is a function of the current real domestic income (Y) domestic prices (P) domestic interest rate (i) and net domestic wealth (W). Equation (6.2) is the money supply identity, defined to be identically equal to the sum of net domestic asset holdings of the central bank (NDA), and the net foreign assets (NFA), (which is also identically equal to the monetary base (H)), multiplied by the money multiplier (U). Equation (6.3) is the money market equilibrium condition (the money supply is equal to the money demand). These equations (6.1 to 6.3) represent the financial sector of the economy. It is assumed, in the spirit of of the IS-LM model that there are two kinds of financial assets in this economy, namely bonds and money. Dropping the bonds market by way of the wealth constraint, the financial assets market is represented by the money market alone. Equations (6.4 to 6.7) represent the external sector, while equations (6.7 to 6.9) represent the real sector. Equation (6.4) is the nominal current account balance. It is expressed as a function of real domestic income (Y), real foreign income (Y^{*}) domestic prices (P), import prices (PI), export prices (PX) nominal exchange rate (E) and the foreign price (P^{*}). Equation (6.5) is the capital account balance, expressed as a function of domestic interest rate (i), the foreign interest rate (i^{*}) and expected depreciation (ΔE^{e}). In reality, in addition to the interest rates, flows of capital into and out of Nigeria are determined by un-measurable non-economic factors, such as political stability, percentage of profits allowed to be repatriated, etc.. Equation (6.6) expresses the balance of payments balance (defined to be the yearly change in the monetary authorities holding of net foreign assets ΔNFA)[1] as the sum of the nominal

[1] *This corresponds to the official reserve settlements (ORS) balance, definition of the balance of*

current and capital account balances. Equation (6.7) is the Keynesian type aggregate demand function, made up of private consumption demand (J), which is a function of the real domestic income, investment demand (I), which is a function of the real interest rate (r), government expenditure (G) and the net foreign demand for domestic goods and services (c) (equivalent to the current account balance described in equation (6.4)). Equation (6.8) is a simple aggregate supply function, expressing output as a positive function of domestic prices. Equation (6.9) is the Fisher equation, expressing the real interest rate as the difference between the nominal domestic interest rate (i) and the expected inflation rate. Finally, equation (6.10) gives the wealth identity, where the net domestic financial wealth is assumed to be equal to the sum of domestic money holding (M) and the domestic holding of bonds (B).

The model represented by equations (6.1) to (6.10) is reduced to equations (6.11) to (6.13) below, by making the appropriate substitutions.

$$\Delta L\,(Y,\ P,\ i,\ W) = \Delta U\,(\Delta NFA + \Delta NDA) = \Delta U \cdot \Delta H \tag{6.11}$$

$$Y(P) = J(Y) + I(i,\ -\pi^{e}) + G + c\,(Y,\ P,\ PI,\ PX,\ E,\ P^{*}) \tag{6.12}$$

$$\Delta NFA = P\,c\,(Y,\ Y^{*},\ P,\ PI,\ PX,\ E,\ P^{*)} + K\,(i,\ i^{*},\ \Delta E^{e}) \tag{6.13}$$

Equation (6.11) is the money market equilibrium expressed in changes. It is arrived at after substituting (6.1) and (6.2) into (6.3) and expressing the result in changes. Equation (6.11) is the goods market equilibrium condition, derived from equating (6.7) and (6.8) after substituting equation (6.9) for the real interest rate. Equation (6.13) is the balance of payments equation (6.6), after substituting (6.4) and (6.5). The three equations (6.11) (6.12) and (6.13) are solved for the three endogenous variables (i), (Y), and (P). After substituting the derived values of (i), (Y), and (P) back into equation (6.13) and solving for the variable (ΔNFA), we arrive at equation (6.14).

$$\begin{aligned}\Delta NFA = {} & Z_1\,\Delta NDA + Z_2\,G + Z_3\,Y^{*} + Z_4\,PI + Z_5\,PX + Z_6\,E + Z_7\,i^{*} \\ & + Z_8\,\pi^{e} + Z_9\,W + Z_{10}P^{*} + Z_{11}\Delta E^{e}\end{aligned} \tag{6.14}$$

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payments. (see Rivera-Batiz et al, 1985 for more discussion on this concept)

Equation (6.14) is the reduced form balance of payments equation derived from the IS-LM-BP type general equilibrium model. It expresses the balance of payments balance as a function of change in the domestic component of the monetary base and other exogenous variables. The coefficient on the change in the domestic component of the monetary base variable (Z_1) represents the short-run offset coefficient.

Equation (6.14) is presented in an empirical form, as (6.15) below.

$$\Delta NFA = c_0 + c_1 \Delta NDA + c_2 G + c_3 Y^* + c_4 i^* + c_5 PX + c_6 PI + c_7 E + c_8 \pi^e + c_9 P^* + c_{10} \Delta E^e + v_t \quad (6.15)$$

The wealth variable has been dropped from (6.15), because it is impossible to define and measure wealth in Nigeria. Once again this equation tries to measure the short-run offset to the domestic component of the monetary base when domestic prices, income and interest rates are allowed to adjust freely.

The short-run offset coefficient c_1 is expected to be negative. As explained in detail in the last chapter, an increase in the domestic component of the monetary base leads to a fall in the foreign component. The signs of c_2, c_3 and c_4 are ambiguous (can either be positive or negative). An increase in the government expenditure (G) is expected to increase aggregate demand, and thus income. An increase in income could lead to an increase in imports; for a given amount of exports, the foreign currency reserves of the country would decrease, rendering a negative relationship between government expenditure and the net foreign assets of the central bank. On the other hand, an increase in income could, according to the monetary approach, lead to an increase in the money demand and reserves inflow. In this case the relationship would be positive. An increase in the foreign real income (Y^*) is expected to encourage foreign countries to import more from the domestic country and thus increase the domestic country's foreign currency reserves. An increase in foreign income is also expected to increase foreign money demand. Following the monetary approach, this could lead to a reserves inflow into the foreign country and as such, a reserves outflow from the domestic country. An

increase in the foreign interest rate (i^*), on the other hand, is expected to lead to outflow of capital from the domestic country, thereby leading to a fall in the domestic country's foreign reserve holding. It could also lead to a decrease in the foreign demand for money, which according to the monetary approach theory will lead to a foreign reserves outflow from the foreign country into the domestic country. In this case c_4 will be positive.

An increase in import prices (PI) would, under normal circumstances, increase the foreign reserves of the country. Domestic residents will try to reduce the purchases of now expensive imported goods and thus cut down on foreign exchange expenditure. This would tend to suggest a positive relationship between import prices and the foreign reserves holdings. The story would, however, be different if goods imported are characterised by a very low import price elasticity. For instance, machinery spare parts and similar kinds of goods which constitute a large percentage of Nigeria's imports, are practically necessities such that even if the price goes up, a certain quantity would have to be bought to keep the factories, vehicles, etc. running. An increase in the import prices (PI) would, in this case, lead to a decrease in the foreign reserves and render a negative relationship between import prices and the net foreign assets of the central bank. An increase in the export prices (PX) is expected to make foreign countries substitute away from the now expensive domestic exports. A fall in domestic exports would lead to a fall in the foreign currency reserves. The relationship can go the other way, if the domestic country's exports are made up of goods that are not easily substitutable (for example, crude oil soon after the OPEC cartel was formed).

Devaluation (a decrease in E), assuming that the Mershal-Lerner condition holds, has been shown to unambiguously increase the net foreign assets of the central bank, (see Frenkel et al 1980, p. 69). A decrease in the amount of foreign currency a unit of domestic currency commands makes domestic goods cheaper and foreign goods more expensive. This will discourage imports and encourage exports as it will cost more in

terms of domestic currency, to import the same quantity now than before; while at the same time foreign countries will find domestic goods cheaper in terms of foreign currency, and thus buy more. The net effect, given that the Mershall-Lerner condition holds, is therefore to improve the trade balance and thus increase the foreign currency reserves of the central bank.

An increase in the expected inflation (π^e) will lower the real interest rate, increase investment and income. An increase in income will encourage imports and for given exports leads to a current account deficit, and outflow of foreign reserves. This tends to suggest a negative relationship between expected inflation and the net foreign assets of the central bank. Following the monetary approach to the balance of payments theory, an increase in income which leads to an increase in money demand has the effect of encouraging reserves to flow into the country and thus suggests a positive relationship between the foreign assets of the central bank and the expected inflation variable.

The reserve flow equation derived in the last chapter is presented in empirical form as equation (6.16) below.

$$\frac{\Delta NFA}{H} = a_0 + a_1 \frac{\Delta NDA}{H} + a_2 \Delta \log Y + a_3 \Delta \log P + a_4 \Delta \log i + a_5 \Delta \log U + e_t \qquad (6.16)$$

As discussed earlier, this equation relates the rate of change in the foreign component of the monetary base (net foreign assets of the central bank) to the rate of change in the domestic component (net domestic assets of the central bank), the rate of change in the domestic real income, domestic prices, domestic interest rate and the money multiplier. The coefficient of the rate of change in the net domestic assets (a_1) is the offset coefficient. This coefficient gives the degree to which any change in the domestic component of the monetary base is offset by change in the foreign component. Generally, the values of the estimated coefficients of equation (6.16) are expected to be as follows: $a_1 = a_5 = -1$, $a_2 > 0$, $a_3 > 0$, $a_4 < 0$.

According to the monetary approach to the balance of payments theory, under a fixed exchange rate regime the change in the foreign component of the monetary base induced by a change in the domestic component is equal in magnitude, but opposite in sign. Therefore, the value of the offset coefficient is always equal to minus one and monetary policy (ΔNDA) is always completely neutralised by the balance of payments (ΔNFA). Furthermore, since the money multiplier is a multiplicative factor in the money supply, its coefficient is also postulated to be equal to minus one. In the case of the remaining variables, their effect on the net foreign assets is believed to be indirectly through the money demand. Increase in domestic income and prices that leads to an increase in the money demand encourages an inflow of foreign reserves, while that of the interest rate which leads to a reduction in the money demand discourages it.

The monetary approach in its extreme form postulates that since the income velocity of money is constant, and people do not suffer from money illusion, the coefficients of the domestic income and domestic price should be not only greater than zero, but exactly positive one.

The monetary policy reaction function, also derived and discussed in chapter 5, is empirically presented as (6.17) below.

$$\frac{\Delta NDA}{H} = b_0 + b_1 \frac{\Delta NFA}{H} 2 + b_2 (\Delta \log Y)_{t-1} + b_3 (\Delta \log P)_{t-1} + b_4 \Delta \log DDBT + u_t \qquad (6.17)$$

The purpose of this equation as stated earlier, is to measure the degree to which the monetary authorities counter the effects of the foreign component of the monetary base on the domestic component (sterilisation). The coefficient of the contemporaneous rate of change in the net foreign assets of the central bank (b_1) represents the sterilisation coefficient. The sign is expected to be negative and a value of minus one is taken to indicate that a country completely sterilises the effect of its balance of payments on the money supply. There are other reasons, besides reacting to the balance of payments

situation, why a country might want to change its money supply by changing the domestic component of its monetary base. It is assumed here that the monetary authorities in Nigeria change their money supply in reaction to the previous year's rate of growth of domestic income $(\Delta \log Y)_{t-1}$, the rate of inflation $(\Delta \log P)_{t-1}$, and the current period rate of growth of domestic debt $(\Delta \log DDBT)$. Both positive and negative signs for (b_2) and (b_3) can be consistently explained. A positive sign for (b_2), for example, could mean that the government is increasing the rate at which it expands the money supply, when there is an increase in the rate of change of real income. In this case, the aim could be to increase the money supply to cater for a possible increase in money demand brought about by the increase in real income. A negative sign on (b_2), on the other hand, could mean that the rate at which the domestic component of the monetary base is expanded, and thus the money supply is increased when the rate of change of income is declining. Monetary authorities may do that if the desire is to increase income/employment by increasing the level of aggregate demand. This situation is not possible under the monetary approach's assumption of full employment of resources.

A positive sign on (b_3) may mean that the authorities expand the rate of change of the money supply when there is an increase in inflation. This may happen if the desire of the monetary authorities is to increase the money supply to make up for the possible increase in money demand brought about by the increase in domestic inflation. A negative sign on (b_3) may mean that the monetary authorities reduce the rate of money supply growth when the rate of inflation is going up. Here the aim of the monetary authorities may be to slow down the growth rate of inflation, by slowing down the growth of the money supply. The central bank is a major holder of the government debt instrument, and therefore, a positive relationship will be expected between the government domestic debt and the central banks net domestic assets. The coefficient b_4 is therefore expected to be positive.

One of the assumptions that underlies the contention that the balance of payments is

a monetary phenomenon is that a country operates a fixed exchange rate regime. Under this assumption, an excess of real money balances brought about by an expansion in the domestic component of the monetary base will lead to a desire to increase the expenditure on foreign goods and assets. This will raise the residents' demand for foreign currencies, and thus place a downward pressure on the exchange rate. If the authorities are to maintain the existing exchange rate, foreign currencies must be sold to the public to satisfy the rising demand. The monetary authorities' holding of foreign currency reserves, and the foreign component of the monetary base (the balance of payments balance) will start to decline. This decline will directly affect the domestic money supply, and will continue until the initial excess money supply is removed and the money market equilibrium is restored, (see chapter 5 for more discussion on this point).

If the exchange rate were allowed to change in response to the downward pressure, the relationship between the domestic money supply and the change in the international reserve component of the monetary base would be weakened. In the extreme case, where the exchange rate is allowed to float freely, the relationship will be completely severed. When there is an excess supply of real money balances, devaluing the currency will lead to an increase in the domestic price level, and thus, reduce the real money balances. If enough devaluation of the currency is allowed to take place, the excess real money balances will be removed, and money market equilibrium will be restored without any change in foreign reserves. If the above statement holds, the balance of payments problem will no longer be a monetary phenomenon, and its correction will no longer depend on correcting disequilibrium in the money market.

To look at it in another way, if there is a balance of payments deficit, caused for example, by an exogenous variable, it will mean that the demand for foreign currency by residents will be rising, placing pressure on the exchange rate to depreciate. Under a fixed exchange rate regime, countries would have to sell foreign reserves to maintain the exchange rate. The act of selling foreign currency reduces the foreign component of the

monetary base, and as a result, the money supply. For a given money demand, this will create a money market disequilibrium. If the exchange rate were allowed to depreciate in response to the downward pressure, the price of foreign currency in terms of the domestic currency will go up and thus reduce the demand for it, without affecting the foreign currency reserves of the central bank and the money supply of the country.

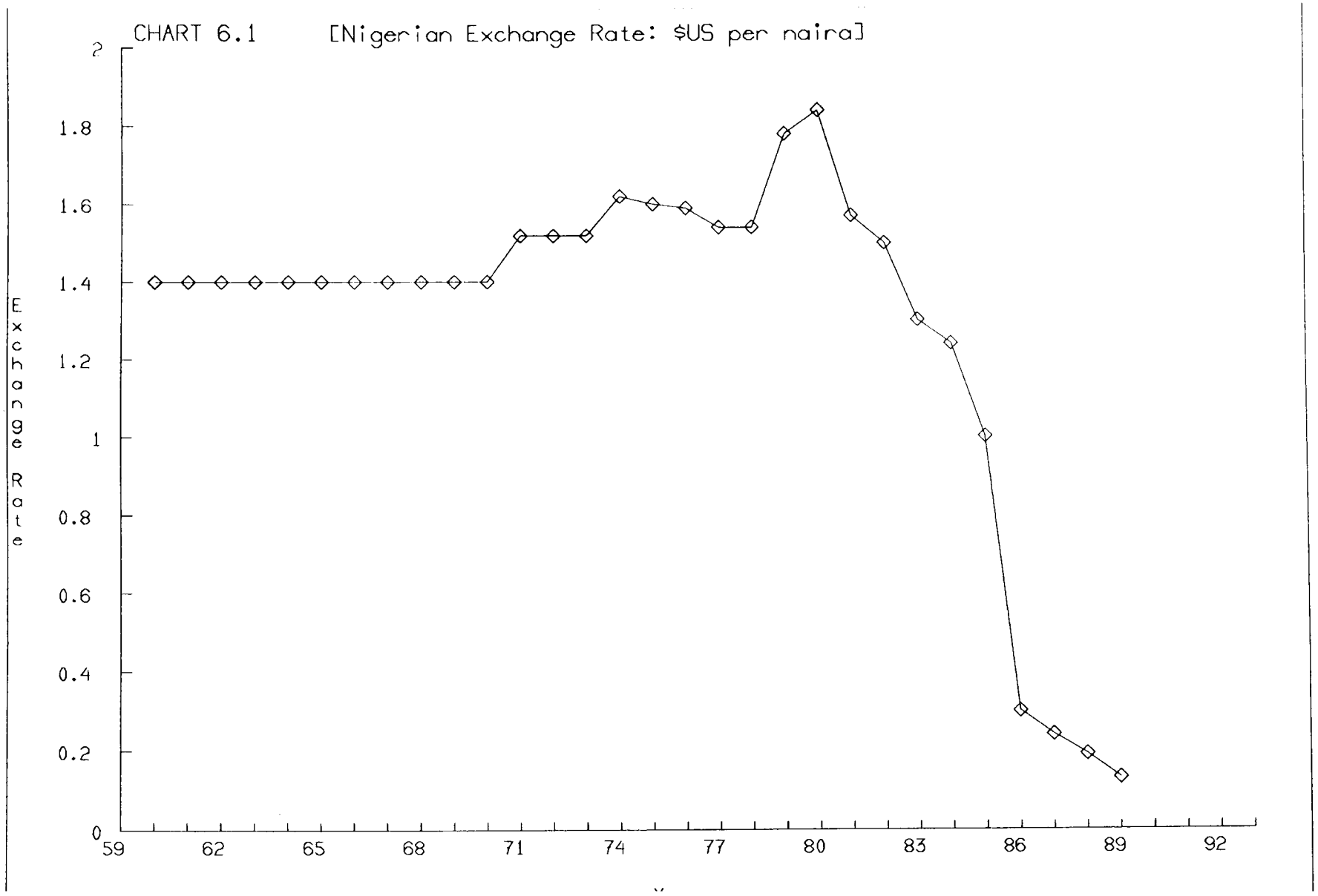
Chart 1.6 below shows that although the Nigerian exchange rate has been relatively fixed for the major part of the period under study (1960 to 1989), it has nevertheless, experienced some fluctuations. It is therefore, necessary to examine empirically the degree to which these fluctuations are in reaction to change in the balance of payments position of the country. This is mainly carried out by estimating an exchange rate change reaction function presented as equation (6.18) below.

$$\Delta \log E = d_0 + d_1 \Delta \log NFA + d_2 \Delta \log P + d_3 \Delta \log EDBT_{t-1} + \varepsilon_t \qquad (6.18)$$

The rate of change in the nominal exchange rate in Nigeria is postulated to depend on the contemporaneous rate of change of the foreign component of the monetary base (NFA), rate of change of domestic prices, and the rate change of the government and government guaranteed external debt.

Defining the exchange rate (E) as the amount of foreign currency a unit of domestic currency commands, one would expect d_1 to be positive. A decline in the central bank's foreign reserves, inherent in a balance of payments deficit, can be brought to a halt or reversed by devaluing the currency, that is, by reducing the amount of foreign currency a unit of domestic currency can buy. This means that the relation ship between the exchange rate and the net foreign assets of the Central Bank will be positive. A reduction in the strength of the domestic currency is expected to lead to an increase in domestic exports, and possibly, start improving the balance of payments position. As in the case of the sterilisation coefficient, the value of d_1 is expected to lie between zero and one. A value of one implies that any change in the foreign component of the monetary base (the balance of payments) is completely insulated from the effect of a change in the money

CHART 6.1 [Nigerian Exchange Rate: $US per naira]



supply (change in the domestic component of the monetary base), by changing the exchange rate. On the other hand, d_1 equal to zero would imply that the balance of payments is not insulated at all from the effect of a change in the money supply, through a change in the exchange rate.

The signs of d_2 can be either positive or negative, but that of d_3 is expected to be positive. When the inflation rate is high, the authorities may devalue the domestic currency to improve the competitiveness of domestic goods abroad, rendering a negative d_2. On the other hand, if the inflation is as a result of increase in the price of imports, it can be relieved by revaluing the currency. This means d_2 will be positive. With regards to d_3, a government might want to re-value its currency in the face of mounting external debt to reduce the value of the debt in terms of domestic currency.

6.3 Econometric Methodology and Estimation Technique

It has been discussed in chapter 5 that, if there is a sterilisation exercise going on, estimating any one of the equations (6.15 6.16, or 6.17), using a single equation estimation technique, is likely to lead to a simultaneity bias. As a result, the equations would be first estimated using the OLS technique, and then by 2SLS. 2SLS would cater for possible simultaneity bias that might arise as a result of any possible sterilisation exercise undertaken.

Besides using OLS and the 2SLS estimation techniques for the various equations, the final reduced form equation from the general equilibrium model (6.15) will be estimated using the time series techniques of cointegration and error correction discussed in chapter 4.

The error correction modelling procedure as applied to the case of estimating the balance of payments offset to monetary policy would require that, in the long-run (equilibrium), the balance of payments should be balanced. Change in reserves (ΔR) would be zero and $R_t = R_{t-1} = R_{t-2}$. The level of reserves would represent the long-run

balance of payments position, while its change (the first difference) would capture the short-run adjustment factors. This applies to all of the independent variables of the general equilibrium balance of payments equation. Running the equation in levels only, therefore, is synonymous to running a long-run (equilibrium relationship). Once again, the interest of this study in estimating the general equilibrium equation is to investigate the short-run balance of payments offset to domestic monetary policy.

6.4 Discussion of the Estimation Results

The coefficient estimates of the reserve flow equation (6.16) for a narrow and broad definition of money[2] are reported in Table (6.1). Both models have passed the standard diagnostic tests. The Lagrange Multiplier test (LM-Test) shows that the null hypothesis that the errors are free of both first and second order serial correlation can not be rejected. The ARCH (Autoregressive Conditional Heteroskedasticity) test shows that the errors are free of heteroskedasticity while the hypotheses that the errors are normal is also accepted, (calculated F and Chi-squared values and their respective degrees of freedom are reported in the Tables).

The offset coefficient in the narrow money reserve flow equation is -1.07, while the coefficients of the real income and the domestic price variables are 0.71 and 0.66 respectively. These three coefficients are highly significant and their values fall within the prior predictions of the monetary approach to the balance of payments theory. The interest rate variable is both insignificant and has the wrong sign. However, this is not entirely surprising, since as mentioned in chapter 4, due to the narrowness of the financial markets and the limited choice of alternative financial assets to money in developing

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[2] *The difference between the reserve flow equations depends on the definition of the money multiplier variable. The money multiplier variable utilised in the narrow definition is* $\frac{M1}{H}$, *while for the broad definition is* $\frac{M2}{H}$; *where* $M1 = C_p + DD$, $M2 = C_p + DD + SD$ *and* $H = C + R$. *DD and SD are demand and savings/time deposits respectively. All other variables are as defined in chapter 2*

economies like Nigeria, interest rates are not good measures of the opportunity cost of holding money. The readily available alternative assets to money open to the inhabitants of most developing countries are in the form of real assets (inflation hedges like grain, land, property, etc.). The common practice is therefore, to use the expected inflation rate as a proxy for the opportunity cost of holding money. Various definitions of expectations were used to create an expected inflation variable,[3] but their use in the reserve flow equations proved to be no better than the interest rate variable.

Table 6.1

The Reserve Flow Equations
(Narrow and Broad Definitions)

	Narrow money M1		Broad Money M2	
VARIABLES	OLS	2SL2	OLS	2SLS
Const.	0.031 (0.78)	0.044 (1.00)	0.063 (2.02)	0.060 (1.89)
$\frac{\Delta NDA}{H}$	-1.07 (-14.99)	-1.13 (-10.83)	-0.96 (-15.81)	-0.94 (11.82)
$\Delta Log\ GDP$	0.714 (2.86)	0.65 (2.45)	0.74 (3.91)	0.76 (3.91)
$\Delta Log\ P$	0.66 (2.84)	0.55 (2.31)	0.51 (2.88)	0.53 (2.91)
$\Delta Log\ DRT$	0.12 (0.62)	0.14 (0.72)	-0.053 (-0.36)	-0.071 (-0.48)
$\Delta Log\ U$	-0.05 (-0.29)	-0.03 (-0.16)	-0.87 (-3.86)	-0.92 (-3.77)
R^2	0.95	0.95	0.97	0.97
Std. Err.	0.119	0.122	0.091	0.091
LM-Test for 1^{st} Order Serial corr.	F(1,19) 0.99	$\chi^2(1)/1$ 0.99	F(1,19) 0.16	$\chi^2(1)/1$ 0.06
LM-Test for 2^{nd} Order Serial corr.	F(2,18) 0.50	$\chi^2(2)/2$ 0.57	F(2,18) 0.08	$\chi^2(2)/2$ 0.03
ARCH -Test for 1^{st} Order Hetero.	$\chi^2(1)$ 0.05	$\chi^2(1)$ 0.57	$\chi^2(1)$ 0.05	$\chi^2(1)$ 0.06
Normality Test	$\chi^2(2)$ 0.317	$\chi^2(1)$ 0.295	$\chi^2(1)$ 0.305	$\chi^2(2)$ 0.313

Dependent Variable: $\frac{\Delta NFA}{H}$

Instruments: Constant term, first and second period lagged of $\frac{\Delta NFA}{H}$, and $\frac{\Delta NDA}{H}$, and one period lagged and non-lagged values of all other independent variables.
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

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[3] *Firstly the actual inflation rate was used, and secondly, expected inflation variable was designed by running the actual inflation rate on one period lagged value of itself and extracting the fitted values.*

The coefficient of the money multiplier in the narrow money reserve flow equation, although of the postulated sign, is very insignificant and the value falls far short of the minus one predicted by the monetary approach theory.

The result of estimating the reserve flow equation for the broader definition of money conforms better with the predictions of the monetary approach theory of balance of payments than the one from the narrow money definition. All variables carry theory consistent signs and are very significant, except the one representing the interest rate. The offset coefficient value of -0.96 and the coefficient of the money multiplier of -0.87 are not significantly different from the minus one value suggested by the theory. It has been argued that using the broader definition of money (M2) for the purposes of analysing the offset to domestic monetary policy is more appropriate for a country like Nigeria, because in the banking institutional framework savings deposits can be turned into cash costlessly, (Ozo-Eson, 1982).

The weakness of the reserve flow equation notwithstanding, the above estimates of the offset coefficients imply that in the long-run, the offset to the domestic component of Nigeria's monetary base is complete. The monetary base is therefore, endogenous and the Central Bank of Nigeria cannot control it in the long-run. Although as shown in chapter 2, the Nigerian money multiplier is fairly stable and predictable when the shocks to the economy are taken into account by the use step dummies, it is nevertheless, independent of the Central Bank control. It is determined by the behaviour of the banks and the non-bank public of Nigeria. Since the ability of the central bank to change the money stock in the context of the money multiplier method of money stock determination depends on its ability to change the monetary base for a given money multiplier, the above findings seem to suggest that the Nigerian Central Bank cannot control the money stock in the long-run. The coefficients of the income and price variable of 0.74 and 0.5, although below the positive one value expected to hold, under the assumption of constant income velocity of money and no money illusion, they

nevertheless conform to the theory in its less stringent form.

This finding does not support the conclusion by Sohrab-Uddin (1985), and Bilquees (1989) that the monetary approach to balance of payments theory is not relevant to developing countries where restrictive credit and reserve policies are pursued. They showed how the coefficient estimates of the reserve flow equation for Pakistan and India, where monetary policy is restrictive and the foreign exchange and capital markets are controlled, are either of the wrong sign, insignificant, or both. For the case of Thailand, where a fairly liberal exchange control policy is maintained, the coefficient estimates are of the expected signs and values, and are significant. Exchange controls, and controls relating to inflow and outflow of financial assets have always been a common feature of the Nigerian financial system and yet its data seems to agree with the monetary approach theory. Watson (1988) reports a similar finding for Trinidad and Tobago. What Nigeria and Trinidad have in common is the fact that their economies are heavily dependent on crude oil. Although these countries have restrictive credit and reserves policy, their economies are very strongly linked to the world economy through crude oil in a way that those of India and Pakistan are not.

The estimated coefficients from using the 2SLS techniques are very similar to those from the OLS techniques. This tends to suggest that simultaneity bias in the OLS results, brought about by the possible endogeneity of some of the independent variables, is unlikely.

It has been discussed in chapter 5 that the most common empirical presentation of the balance of payments equation, in the context of the monetary approach theory (the reserve flow equation (6.16)) is inadequate on many grounds. For example, it has been argued that it is derived from the money market equilibrium conditions alone, neglecting all other sectors of the economy. Furthermore, the reserve flow equation presumes a long-run scenario, while for policy purposes, the short-run is more relevant. As a result, a balance of payments equation from a more general model, which is also suitable for a

short-run analysis (equation 6.15), will be estimated. As discussed earlier, this equation will be estimated using the dynamic modelling and estimation technique of error-correction and cointegration. It has also been stated earlier that this form of dynamic modelling requires some prior testing and analysis of the individual series. The result of testing for the order of integration of each Nigerian series, using the ADF method, is reported in Table 6.2. The test indicates that all series achieve stationarity after differencing once.

Table 6.2

Order of Integration of the Series
ADF-Test

VARIABLES	ADF-TEST FOR I(0)		ADF-TEST FOR I(1)		ORDER OF INTEGRATION
	(LEVELS)		(FIRST DIFFERENCE)		
	COEFF	t-VALUES	COEFF	t-VALUES	
NFA	-0.36	(-2.3)	-1.34	(-5.04)	I(1)
NDA	0.063	(0.53)	-1.21	(-3.48)	I(1)
E	-0.002	(-0.019)	-0.67	(-2.85)	I(1)
Y^*	0.006	(0.366)	-1.03	(-3.90)	I(1)
i^*	-0.306	(-2.55)	-1.11	(-4.58)	I(1)
PI	-0.002	(-0.086)	-0.60	(-3.30)	I(1)
PX	-0.09	(-1.27)	-0.86	(-3.35)	I(1)
G	-0.15	(-1.43	-1.06	(-3.28)	I(1)
π^{e}**	-0.53	(-1.26)	-3.30	(-9.40)	I(1)
ΔE^{e}**	-0.67	(-2.80)	-2.40	(-6.25	I(1)

ADF-Test requires running the following:

$$\Delta X_t = a + bX_{t-1} + \sum_{i=1}^{n} \Delta X_{t-i} + e_t$$

Coeff. represents the estimates of b, with t-values in parenthesis.
Critical t-values for ADF-Test are -3.75(1%), -3.00(5%), -2.63(10%); for N=25.
** Expected inflation and expected devaluation are proxied by the actual inflation and the actual devaluation.

Testing for cointegration of the Nigerian data series strongly rejects the null hypothesis that the series are not cointegrated. This is evident from both the CRDW statistics and the ADF-test for unit-root of the residuals from the cointegration regression (hereafter referred to as the ECT, see Tables 6.3 and 6.4). The calculated CRDW is 2.20, while the calculated t-value of interest using the ADF-test is -5.10. The critical CRDW at 5% is 0.872, while that of the ADF-test for a unit root of ECT is about -4.67, (see Engle and Yoo, 1987).

Table 6.3

Cointegration Regression Equation						
const.	NDA	E	PX	G	ΔE^e	CRDW
6516.3 (10.65)	-0.66 (-8.50)	-5076 (-11.41)	42.85 (6.62)	0.089 (7.11)	3210.4 (4.54)	2.20

Dependent Variable: NFA
Critical CRDW at 5% = 0.827
t-values are in parenthesis.
Note. The expected devaluation variable (ΔE^e) is proxied by the actual, and this may lead to a measurement error.

Table 6.4

Testing the Cointegration Regression Residuals for I(0) ADF-Test				
Const.	$(\Delta ECT)_{t-1}$	$(ECT)_{t-1}$	$\bar{R}^2$	Durbin -h
-2.24 (-0.03)	0.39 (1.70)	-1.57 (-5.10**)	0.60	-0.78

Dependent Variable: ΔECT.
ECT is the Residuals from the Cointegration Regression (Table 6.3).
** Relevant t-value for cointegration test.

Parsimonious models of the quasi reduced form-behavioural equation (6.15), using the Engle Granger two-steps approach, are reported in Table 6.5. Starting out from models with all the explanatory variables, a thorough specification search is conducted to arrive at the reported models. The models have passed the regular specification and validation tests (see Table for results). Adjacent to each variable in the Table (variables have been defined in an earlier section of this chapter) are the coefficient estimates and the t-values (t-values are in brackets). All variables that appear in the models are very significant. The estimated coefficient of the change in the net domestic assets (the short-run offset coefficient) is -0.84. This value is almost as high as the offset coefficient derived from the reserve flow equations and it is not statistically different from minus one. This finding seems to suggest that, even in the short-run when domestic prices, income and interest rates are assumed endogenous, the offset to the domestic component of the monetary base by the foreign component is complete. The ability of the Central Bank of Nigeria to control the money stock is limited not only in the long-run, but in the short-run as well.

The coefficient of the change in the exchange rate variable is negative, confirming that devaluation of the Nigerian currency improves the balance of payments and thus increases the net foreign assets of the Central Bank.[4] Specifically, a dollar reduction in the amount of US dollars one Nigerian naira can command, will lead to an increase in the net foreign assets of the Central Bank by more than 1000 million naira. A million dollar increase in foreign income raises the foreign assets by about 7 million naira.

The estimated coefficient of the imports prices is negative in sign, indicating that when it goes up, the net foreign assets of the Central Bank declines. Normally one would expect the relationship to be positive, because an increase in the price of imports will reduce the quantity imported, improve the balance of payments position and increase the foreign reserves of the central bank. However, if a country's imports are the bare necessities, as in Nigeria, an increase in import prices will not lead to a decline in the quantity imported and with it the foreign exchange expenditures on these imports, but instead the same quantity would have to be imported at the now high price, and as such, there will be an increase in the total foreign exchange spent and a decline in the foreign assets of the central bank.

Contrary to expectation, a rise in the price of Nigerian exports improves the balance of payments and increases the Central Bank's net foreign assets. This is mainly due to the advent of the OPEC cartel. Since its formation, the price of crude oil has gone up quite considerably. Given that crude oil was not easily substitutable as a source of energy, exporters of crude oil experienced a situation where the price of their exports was going up, but at the same time, the revenue they derived from such exports was also going up. It is therefore not surprising to see Nigeria's export price (a country whose export composition is more than 90 percent crude oil), and change in its foreign reserves, (which is mainly from crude oil sales) moving in the same direction.

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[4] *Note: The exchange rate is here defined as the amount of US dollars one Nigerian naira can buy.*

Table 6.5

Reduced Form Equation for Short-run Offset with step Dummies Using Engle-Granger 2 Steps Approach		
VARIABLES	OLS	2SLS
Const.	-227.87 (-1.84)	-227.17 (-1.83)
ΔNDA	-0.84 (-19.83)	-0.85 (-19.70)
ΔE	-1168.31 (-1.92)	-1165.49 (-1.91)
ΔY^*	7.22 (1.93)	7.23 (1.93)
ΔPI	-30.48 (-2.32)	-31.14 (-2.36)
ΔPX	41.43 (5.97)	41.54 (5.99)
ΔG	0.087 (8.64)	0.086 (8.64)
D1973/74	444.34 (3.69)	447.88 (3.71)
D1985/86	1368.82 (5.74)	1378.50 (5.77)
$(ECT)_{t-1}$	-1.16 (-6.75)	-1.16 (-6.76)
R^2	0.98	0.98
Std. Err.	235.94	236.02
LM-Test for 1^{st} Order Serial correlation	F(1, 16) 0.11	$\chi^2(1)/1$ 0.18
LM-test for 2^{nd} Order Serial correlation	F(2, 15) 0.06	$\chi^2(2)/2$ 0.20
ARCH-Test for 1^{st} Order Heteroskedasticity	$\chi^2(1)$ 0.75	$\chi^2(1)$ 0.75
Normality -Test	$\chi^2(2)$ 1.84	$\chi^2(2)$ 1.82

Dependent Variable: ΔNFA
INSTRUMENTS: constant term, one period lagged ΔNFA, ΔNDA and one period lagged and non-lagged of all other independent variables.
t-values are in parenthesis
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 6.5.1

Reduced Form Equation for Short-run Offset with no Dummies
Using Engle-Granger 2 Steps Approach

VARIABLES	OLS	2SLS
Const.	-334.08 (-1.80)	-333.84 (-1.80)
ΔNDA	-0.71 (-10.43)	-0.72 (-8.94)
ΔE	-3544.95 (-4.01)	-3575.23 (-3.97)
ΔY^*	13.31 (2.13)	13.41 (2.14)
ΔPI	18.09 (0.92)	17.46 (0.87)
ΔPX	51.43 (4.42)	51.84 (4.37)
ΔG	0.10 (5.52)	0.10 (5.52)
D1973/74		
D1985/86		
$(ECT)_{t-1}$	-1.46 (-4.86)	-1.47 (-4.77)
R^2	0.91	0.90
Std. Err.	426.51	426.65
LM-Test for 1^{st} Order Serial correlation	F(1, 18) 3.91	$\chi^2(1)/1$ 3.81
LM-test for 2^{nd} Order Serial correlation	F(2, 17) 1.61	$\chi^2(2)/2$ 1.68
ARCH-Test for 1^{st} Order Heteroskedasticity	$\chi^2(1)$ 0.67	$\chi^2(1)$ 0.56
Normality -Test	$\chi^2(2)$ 1.28	$\chi^2(2)$ 1.40

Dependent Variable: ΔNFA
INSTRUMENTS: constant term, one period lagged ΔNFA, ΔNDA and one period lagged and non-lagged of all other independent variables.
t-values are in parenthesis
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Table 6.5.2

Reduced Form Equation for Short-run Offset with Impulse Dummies Using Engle-Granger 2 Steps Approach		
VARIABLES	OLS	2SLS
Const.	-378.65 (-1.86)	-386.80 (-1.90)
ΔNDA	-0.70 (-7.33)	-0.74 (-6.26)
ΔE	-3631.05 (-2.31)	-4101.61 (-2.35)
ΔY^*	14.56 (2.20)	14.81 (2.22)
ΔPI	18.70 (0.68)	21.95 (0.79)
ΔPX	47.04 (3.53)	47.97 (3.48)
ΔG	0.10 (5.08)	0.10 (5.08)
ΔD1973/74	477.11 (0.83)	-627.93 (-0.40)
ΔD1985/86	-236.73 (-0.17)	378.90 (0.63)
$(ECT)_{t-1}$	-1.45 (-4.26)	-1.54 (-4.18)
R^2	0.91	0.91
Std. Err.	441.03	443.78
LM-Test for 1^{st} Order Serial correlation	F(1, 16) 1.43	$\chi^2(1)/1$ 2.18
LM-test for 2^{nd} Order Serial correlation	F(2, 15) 0.69	
ARCH-Test for 1^{st} Order Heteroskedasticity	$\chi^2(1)$ 0.73	$\chi^2(1)$ 0.44
Normality -Test	$\chi^2(2)$ 2.60	$\chi^2(2)$ 2.03

Dependent Variable: ΔNFA
INSTRUMENTS: constant term, one period lagged ΔNFA, ΔNDA and one period lagged and non-lagged of all other independent variables.
t-values are in parenthesis
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

An increase in government expenditure also increases the net foreign assets of the Central Bank. However, in this case the small coefficient of about 0.087 means that an increase in (G) by one million will increase the net foreign assets by about 87 thousand naira. Dummy variables to represent the 1973/74 oil price increase (D1973/74) and the devaluation of the Nigerian naira due to the introduction of the second-tier foreign exchange market in 1986 (D1985/86) are both found to be very significant. As discussed in section 2.3.3 of chapter 2, the price of Nigerian crude oil went up by about 250 percent within a period of 4 months (October 1973 to January 1974). The foreign assets of the Central Bank of Nigerian went up from 389 million naira in 1973 to 3,586 million in 1974. It was also discussed in the same section that in September, 1986 the Nigerian naira was devalued by over 66 percent. The effect of this on the Central Bank's foreign assets denominated in naira was to increase it from 1,686 million in 1985 to 3637 million by the end of 1986.

Although the coefficient representing the error-correction term has the right sign and is very significant, it is greater than minus one in absolute value. This means that when the system is moving back to equilibrium after some disturbance, it will "over-shoot" the equilibrium before it settles down (a stable dynamic structure).

The result of estimating the same equation (6.15) using the 2SLS technique is reported in the same table. As in the case of the reserve flow equations, the parameter estimates are found to be very similar to those obtained from using the OLS technique, (see Table for instruments utilised).

Although effects of the 1973/74 oil price increase and the 1985/86 devaluation on the net foreign assets of the Central Bank has been explained above, as in the models in the earlier chapters, it may be interesting, for comparison purpose, to estimate the models without dummies and with impulse dummies. The result of these models are presented in Tables 6.5.1 and 6.5.2. They are quite similar to the ones obtained by using step dummies (Table 6.5); with the exception of the fact that in the former cases, the import

price variable is not significant and the offset coefficients are slightly lower. Furthermore, the impulse dummies were found to be insignificant. Also, the standard error in the equation with step dummies is about half that of the other equations.

The result of estimating the monetary policy reaction function (6.17) for Nigeria is reported in Table 6.6. The model passes all the regular diagnostic tests as well, (see Table for the results of these tests). All estimated coefficients are significant and of the expected signs. A positive relationship between the growth rate of the net domestic assets of the Central Bank, previous periods growth rate of real income, and the previous period's growth rate of domestic prices indicates that the money supply is increased when real income and the domestic prices are growing. This may mean that the Nigerian monetary authorities increase the money supply to meet the increase in the transactions demand for money inherent in growth of real income and prices. The positive relationship with the domestic debt variable indicates that increases in the Government's domestic debts increases the net domestic assets of the Central Bank. This simply confirms that the Central Bank of Nigeria is a major source of funds for the Government's deficit financing.

The estimated coefficient of the contemporaneous rate of growth of the net foreign assets is -0.77; suggesting that over 70 percent of the effect the foreign component of the monetary base has on the domestic component is sterilised. The principal tool for sterilisation is open market operations. If there is an increase in the foreign component of the monetary base, securities can be sold in the open market, thus reducing the domestic component of the monetary base, and vice versa. However, as discusssed in chapter 5, this operation can only be successfully carried out if there is an efficient and fairly developed financial market. In Nigeria, as discussed in chapter 1, although Treasury bills are often bought and sold, open market operations in the traditional sense have never been conducted. Sterilisation in Nigeria basically takes the form of purchases and sales of treasury bills and other government securities by the monetary authorities

to/from the Central Bank, commercial banks, and government parastatals. For example, sterilising a payments deficit will require the monetary authorities to sell Treasury bills and use the proceed to finance government expenditure. Since the Central Bank is a major holder of Treasury bills, its holding of domestic assets go up. Conversely, if there is a payments surplus such that the net foreign assets of the Central Bank are going up, Treasury bills are bought back. This means that sterilising a surplus is going to lead to a decline in government expenditures.

Table 6.6

Monetary Policy Reaction Functions		
VARIABLES	OLS	2SLS
Const.	-0.042 (-1.12)	-0.048 (-1.21)
$\frac{\Delta NFA}{H}$	-0.77 (-20.08)	-0.72 (-14.08)
$(\Delta \log GDP)_{t-1}$	0.54 (3.12)	0.54 (3.02)
$(\Delta \log P)_{t-1}$	0.43 (2.81)	0.35 (2.13)
Δ log DBBT	0.40 (3.44)	0.44 (3.56)
R^2	0.96	0.96
Std. Err.	.084	.085
LM-Test for 1^{st} Order Serial correlation	F(1, 20) 0.45	$\chi^2(1)/1$ 0.86
LM-Test for 2^{nd} Order Serial correlation	F(2, 19) 3.51	$\chi^2(2)/2$ 2.23
ARCH-Test for 1^{st} Order Heteroskedasticity	$\chi^2(1)$ 0.71	$\chi^2(1)$ 0.08
Normality-Test	$\chi^2(2)$ 0.11	$\chi^2(2)$ 0.51

Dependent Variable: $\frac{\Delta NDA}{H}$.

Instruments: Constant term, one and two periods lagged of $\frac{\Delta NDA}{H}$, $\frac{\Delta NFA}{H}$ and one period lagged and non lagged values of all other independent variables.
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990) PC-Give Version 6.0.

Evidence does not seem to support that Nigeria sterilised both payments deficits and surpluses. In fact, looking at Table 6.7, it is clear that a decline in the foreign component of the monetary base was not allowed to affect the money stock. For example, in 1961 to 1963, 1976 to 1978, and 1981 to 1983, Nigeria experienced a decline

in the foreign component of its monetary base, but that did not lead to a decline in the money stock. Instead, the money stock went up in those periods. This is clear evidence that Nigeria did sterilise payment deficits. However, the same is not true of periods when there were increases in the foreign component of the monetary base. These increases are

Table 6.7

Net Foreign Assets, Money Stock and their % Changes				
YEAR	NFA	M1	%ΔNFA	%ΔM1
1960	246	241		
1961	220	243	-10.57	0.83
1962	206	253	-6.36	4.12
1963	150	269	-27.18	6.32
1964	163	318	8.67	18.22
1965	171	328	4.91	3.14
1966	154	357	-9.94	8.84
1967	80	323	-48.05	-9.52
1968	83	338	3.75	4.64
1969	95	447	14.46	32.25
1970	157	643	65.26	43.85
1971	280	670	78.34	4.20
1972	246	747	-12.14	11.49
1973	385	926	56.50	23.96
1974	3453	1757	796.88	89.74
1975	3574	2605	3.50	48.26
1976	3283	3864	-8.14	48.33
1977	2762	5558	-15.87	43.84
1978	1308	5101	-52.64	-8.96
1979	3059	6147	133.87	20.51
1980	5445	9227	78.00	50.11
1981	2428	9745	-55.41	5.61
1982	1042	10049	-57.08	3.12
1983	727	11283	-30.23	12.28
1984	1104	12204	51.86	8.16
1985	1661	13227	50.45	8.38
1986	3542	12663	113.25	-4.26
1987	4620	14906	30.43	18.29
1988	2243	21446	-51.45	43.87
1989	11308	25812	404.15	20.36

Sources: IMF International Financial Statistics.

almost always reflected in the money stock. For example, in 1970 when the Nigerian civil war ended, the net foreign assets of the Nigerian Central Bank went up by about 65 percent, while the money stock went up by about 43 percent. The same goes for other periods of massive increases in the Central Bank's net foreign assets, for instance the first and the second oil price increase. Although the percentage increase in the money stock

was always lower than the increase in the foreign component of the monetary base, they nevertheless show that Nigeria did not completely sterilise payments surpluses.

The above discussion seems to cast some doubt over the result from estimating the monetary policy reaction function that Nigeria sterilises nearly 80 percent of the effects of balance of payments on the domestic money supply. Moreover, Granger causality tests between the net foreign assets and the net domestic assets of the Central Bank showed that there is a bidirectional Granger-causality between the variables; implying that a clear cut claim for sterilisation cannot be made.

It has been discussed in the last chapter that if a partial sterilisation is going on, it is likely that OLS estimates of the offset coefficient and the sterilisation coefficient would be biased. This is partly due to the likelihood of the simultaneity problem. The variable representing the domestic component of the monetary base in equation (6.16) and that representing the foreign component in equation (6.17) would both be endogeneous in the estimation process. Coefficient estimates from these equations, using OLS are likely to be biased and inconsistent. In the literature, in addition to OLS, 2SLS is used to estimate the reserve flow equation and the monetary policy reaction function. If no real difference is found between the estimates of the OLS and 2SLS, the possibility of the simultaneity problem is then discounted away, (see for example, Watson, 1988, Kamas 1986, etc.). The shortcoming of this method of checking for a possible existence of the simultaneity problem has been discussed in section 4.6 of chapter 4. These short comings are even clearer when looking at Tables 6.1 and 6.6. Although 2SLS estimates in both cases suggest that there is no simultaneity problem, coefficient estimates of the domestic component and the foreign component of the monetary base when used as independent variables are quite significant in the two equations, implying that they cause each other.

In view of the above discussion, caution should be exercised in interpreting the results from the reserve flow equation and the monetary policy reaction function. This weakness applies to the whole of the literature on estimating offset and sterilisation

coefficients.

A number of models for the exchange rate change reaction function, depending on the specification of the dummy variable[5] are presented in Table 6.8. Column 2 of the Table gives the result of estimating the equation with a step dummy. Lagrange multiplier tests accept the hypothesis that the residuals from the regression are not serially correlated (first order at 10 percent level and second order at 5 percent level). The model also passes the other specification tests as well (see Table). All estimated variables of this equation are quite significant, and the coefficient estimates carry the expected signs. The coefficient of the contemporaneous change in the net foreign assets (NFA) which is equivalent to a change in the balance of payments balance, is about 0.000053. This seems to suggest that, all other things held constant, a one percent change in the balance of payments position of Nigeria leads only to a 0.005 percent change in the exchange rate. In other words, less than .005 percent of the changes in the exchange rate in Nigeria was due to the balance of payments position of the country. Estimated coefficients of change in the domestic prices, and the government and government guaranteed external debt are 0.015 and -0.0002 respectively. Other things being equal, about 15 percent of the change in the nominal exchange rate in Nigeria is due to the change in the domestic price level, while about 0.002 percent is due to the change in the foreign debt position of the country.

Column 3 of Table 6.8 gives the result of estimating the exchange rate change reaction function when an impulse dummy is used. The regular diagnostic requirements are met, except for the normality condition. The normality Chi-squared value of 14.32 indicates that the errors are not normally distributed. However, this equation has a lower standard error and a higher R-squared than the one in column 2. The coefficient of the

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[5] *The dummy variable is to capture the 1985/86 devaluation of the Nigerian naira. Although the exchange rate of the Nigerian naira has been declining gradually since 1980, between 1984 and 1985 it experienced a massive fall of over 300 percent (from 1 to 1 to 1 to 0.3 US dollars). As discussed in chapter 1, this massive devaluation was undertaken as part of the IMF -imposed structural adjustment programme.*

ΔNFA is the same in the two equations. The other coefficients of the model in column 3 are not significant except that of the dummy variable. The result of estimating the equation without dummy variables is given in column 4 of the table. Although the coefficient of the ΔNFA is quite close to those obtained from the other equations, this model could not pass the first and second order serial correlation tests even at the 10 percent level.

Table 6.8

Exchange Rate Change Reaction Function			
VARIABLES	Step Dummy	Impulse Dummy	No Dummy
Const	-0.043 (-1.75)	0.00057 (0.027)	-0.05 (-1.92)
Δ NFA	0.00005 (2.64)	0.00005 (3.48)	0.00004 (2.12)
Δ P	0.010 (3.19)	-0.005 (-1.21)	0.11 (3.33)
Δ EDBT	-0.000024 (-3.33)	0.000002 (0.61)	-0.00001 (-5.46)
D1985/86	0.69 (2.03)	-0.89 (-4.83)	- -
$\bar{R}^2$	0.62	0.78	0.55
Std. Err.	0.107	0.082	0.114
LM-Test for 1^{st} Order Serial corr	F(1, 22) 5.51	F(1, 23) 2.02	F(1, 23) 12.31
LM-Test for 2^{nd} Order Serial corr	F(2, 21) 2.40	F(2, 21) 1.22	F(2, 21) 5.89
ARCH-Test for 1^{st} Order Hetero	$\chi^2(1)$ 2.77	$\chi^2(1)$ 0.033	$\chi^2(1)$ 3.28
Normality-Test	$\chi^2(2)$ 0.90	$\chi^2(2)$ 14.32	$\chi^2(2)$ 3.26

Dependent Variable: ΔE
t-values are in parenthesis.
Econometric Estimation Package: Hendry (1990), PC-Give Version 6.0.

6.5 Summary and Conclusions

This chapter has investigated the degree to which the foreign component of the monetary base offsets the domestic component in Nigeria. Two sets of equations (the reserve flow equation and a quasi reduced form behavioural equation from an IS-LM-BP type general model) plus a monetary policy reaction function and an exchange rate change reaction function are estimated. The quasi reduced form-behavioural equation is

modelled and estimated using the dynamic modelling and estimation procedure of error correction and cointegration. In addition, all the equations are estimated using both OLS and 2SLS techniques.

The estimated coefficients of the reserve flow equations, especially when a broad definition of money is used, is in conformity with the monetary approach to the balance of payments theory. The offset coefficient values of (-1.07) and (-0.96) for narrow and broad definitions of money respectively are not different from the (-1.0) value postulated by the theory. Also, the income and the price elasticities are both found to be positive as expected. The estimated coefficients of the opportunity cost of holding money, although of the postulated sign, are found to be insignificant. This can be explained by lack of an appropriate variable to represent the opportunity cost of holding money in a developing economy like Nigeria. The estimated coefficients of the money multiplier variables have the expected negative sign, but are significant with a value of close to minus one only in the broadly defined case. According to the reserve flow equation, the Nigerian monetary base is completely endogenous and the Central Bank cannot carry out any effective discretionary monetary policy by changing the domestic component of the monetary base in the long-run (when the income, prices, and interest rates are assumed to be constant).

The coefficient estimates of the general equilibrium equation convey the same message as those of the reserve flow equation. The offset coefficient in this case, is between -0.70 and -0.84, depending on the specification the dummy variables. This suggests that, even in the short-run when domestic income, prices, and interest rates are allowed to vary, between 70 and 80 percent of any change in the domestic component of the monetary base is offset by the foreign component.

The coefficient estimate of the contemporaneous change in the foreign reserve in the monetary policy reaction function of Nigeria is (-0.77). This seems to imply that Nigeria sterilises over 70 percent of the effect which the foreign component of its monetary base has on the domestic component. This means that the monetary base may in fact be

partially exogenous in the short-run. In the very long-run, continuous sterilisation of payments deficits and surpluses would be halted by exhaustion of either the foreign currency reserves of the Central Bank or its stock of domestic securities. Moreover, evidence seems to suggest that Nigeria only sterilises payments deficits completely, but allows payments surpluses, at least partially, to affect the money stock. The sterilisation coefficient of nearly 0.80 may therefore, be an overestimate of the actual level of sterilisation undertaken in Nigeria. Either way, the implication is that the Nigerian monetary base is likely to be endogenous and cannot be controlled by the Central Bank.

The coefficient estimate of the contemporaneous change in the net foreign asset of 0.00005 in the exchange rate change reaction function seems to suggest that Nigeria did not change its exchange rate, in reaction to changes in its balance of payments position.

General Summary and Conclusions

The Economic Community of West African States (ECOWAS) is an economic organisation of 16 countries of Africa south of the Sahara. The aim of the organisation, which came into existence in 1975, is to form an economic union among the member nations.[1] A vital part of this programme is to establish a single central bank which not only issues a single currency for all member nations, but also pools their foreign exchange reserves and coordinates their monetary and fiscal policies.

Although it may be beneficial for a country to be a member of this type of monetary cooperation, there are also costs associated with it. The most obvious of these costs is the loss of independence in carrying out macro-economic policies. Specifically, a country cannot change its money supply for monetary policy purposes, independent of the other countries, when and as it sees fit. Any monetary policy decision would have to be taken collectively and at certain agreed intervals.

This study has assessed the degree to which Nigeria is likely to lose monetary policy independence in the event of a successful implementation of the ECOWAS monetary unification programme. Since the monetary union is not in operation yet, the issue was examined indirectly by addressing the following question: Does Nigeria have monetary policy independence at present? In other words, can the Nigerian Monetary Authorities conduct an effective monetary policy now? For the purpose of this study, monetary policy is defined as changing the money stock to achieve certain internal or external goals.

According to the money multiplier theory of money stock determination, the money stock at any given point in time is identically equal to the money multiplier times the

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[1] *There is an interesting parallel with recent proposals for economic and monetary integration in the ECC.*

monetary base. The money multiplier is determined by the non-bank public's currency to deposit ratio and the banks' reserve to deposit ratio. Therefore, it is generally assumed to be beyond the control of the monetary authorities. The monetary base, on the other hand, is made up of the liabilities of the central bank, and as such can be controlled. In other words, the monetary base is assumed to be exogenously determined by the monetary authorities: for a given level of the money multiplier, a change in the money stock requires changing the monetary base in the desired direction. Successful manipulation of the money stock will only occur if the money multiplier is stable and predictable. If the money multiplier moves around and its value cannot be predicted accurately, a given change in the monetary base may not lead to the desired level of money stock.

Casual observation of the graphs of the Nigerian money multiplier and those of the determinants from 1960 to 1989 (Charts 2.1 to 2.3) suggests that they may be unstable because they have experienced some large year to year fluctuations. However, section 2.3 showed that most of these fluctuations are a result of various random shocks which affected the Nigerian economy. For example, phenomena like the Nigerian Civil War, the first and second oil price increases, and the structural adjustment programme undertaken in the mid 1980s have all affected the money multiplier and its determinants quite considerably. Therefore, it may not be appropriate to come to a conclusion about the stability/instability of the Nigerian money multiplier simply by observing its year to year fluctuations. In fact, what may be more important for the purpose of analysing the ability of a country's monetary authorities to control the money stock in the context of the money multiplier approach, is the predictability of the money multiplier. One way of measuring how predictable the money multiplier and its components are is to model them econometrically and measure the degree to which the estimated econometric models can forecast the future. Looking at the stability of the money multiplier in this manner will allow the effects of shocks and regime shifts to be handled using dummy variables.

In the last part of chapter 2 the Nigerian currency to deposit ratio, reserves to deposit ratio, and the money multiplier are modelled as functions of a set of explanatory variables. The test of the models' abilities to forecast is carried out by omitting a certain number of observations from the models and allowing the models to forecast these values; then comparing the actual and the forecast values. Furthermore, Chow-Tests for parameter constancy between the sample and the forecast period to measure the overall stability of the models are also carried out. Forecast Chi-squared tests showed that all the models have good forecast ability, while the Chow-tests showed that the hypothesis of parameter constancy cannot be rejected. However, the broadly defined currency to deposit ratios (denominator is the sum of demand, savings and time deposits as opposed to just demand deposits) and the broadly defined money multiplier (M2/monetary base) are found to have a poor forecast ability. The models for the reserves to deposit ratios (both broad and narrowly defined) have very good forecast ability. These results seem to indicate that for the purpose of money stock control, the narrow definition of money is more appropriate for Nigeria, confirming an earlier finding by Ojo (1976). Despite the year to year fluctuations, the econometric models showed that the Nigerian money multiplier and the determinants are reasonably stable and their values in the future can be predicted with some degree of accuracy.

These results are arrived at after step dummies were used to account for the major shocks to the Nigerian economy. When the equations were estimated without the dummy variables, or when impulse rather than step dummies were used, only the narrowly defined currency to deposit ratio has a good ex-ante forecast ability. Although the estimated models of the reserve to deposit ratios are found to have poor ex-ante forecast abilities, tests showed that the hypothesis that the models are stable can not be rejected.

Being able to predict the value of the money multiplier is only one half of the task. The other half is to be able to control the monetary base. Although the monetary base is the liability of the central bank, it may in fact be endogenous and therefore cannot be

controlled at will. The Post-Keynesians argue that the monetary base and the money stock are both endogenous, responding only to a change in the credit demand. When the demand for credit goes up, the supply of credit will also go up. An increase in the supply of credit will lead to an increase in deposits with the banking institutions, since the proceeds of the loan would have to be eventually deposited. When deposits go up, the total reserves of the banking institutions go up, because a certain percentage of all deposits would have to be held as reserves. Deposits are a component of the money stock while banks' reserves are a component of the monetary base. The other component in both cases is the currency in circulation. Causation, according to the Post-Keynesians, runs from credit demand to money stock, and from money stock to the monetary base. The base is endogenous and cannot be controlled by the monetary authorities.

An empirical test of the above proposition was carried out in chapter 3. It basically requires testing for the direction of causality between domestic credit and the money stock, and then between the money stock and the monetary base. In this study the Granger-causality test is used to measure whether the direction of causality between credit and money stock, and money stock and the monetary base in Nigeria is as postulated by the Post-Keynesians. According to this test, a series (X) causes another (Y) if taking account of past values of (X) leads to improved prediction for (Y). Applying this to the Nigerian data showed that when the narrow definition of money (M1) is considered, causality runs from money stock to monetary base, but when the broader definition of money (M2) is considered, the relationship is that of feedback. When the test was applied to money and domestic credit, it was found that domestic credit Granger causes narrow money (M1), but as in the case of money-monetary base, the causal relationship between domestic credit and broad money is that of feedback. These results seem to suggest that the money stock and the monetary base in Nigeria are likely to be endogenous and not exogenously determined by the monetary authorities. Although slightly weaker, similar results were obtained when the Granger-causality tests were

carried out without any dummy variable and with impulse dummies. The interpretation of the result from the Granger-causality test would have to be treated cautiously, because the test has been criticised as simply measuring which variable precedes the other, rather than causality in the theoretical sense. Nevertheless, if the result of this test can be accepted, the conclusion is that the Nigerian Monetary Authorities cannot change the monetary base, and are highly unlikely to change the money stock for monetary policy purposes in the context of the money multiplier approach to the money stock determination.

Given that the monetary base and the money stock in Nigeria are likely to be demand determined, one possible way for the Nigerian monetary authorities to change the money stock for monetary policy purposes is to change the money demand. To successfully change the money stock through the demand for it, there has to be a stable money demand function which is significantly linked to a control variable. To test the stability of the Nigerian money demand function, chapter 3 estimated three different specifications using Nigerian data. The result of estimating the partial adjustment model showed that it is possible to obtain a stable money demand function for Nigeria. Models for narrow and broad definitions of money pass all the regular specification and validation tests. The estimated coefficient value of about 0.50 on the lagged dependent variable indicates that it takes about two years for an equilibrium to be re-established after a disturbance. The short-run and the long-run income elasticities of money demand in Nigeria are about (0.88) and (1.40) respectively. Although the interest rate variable in the money demand function has the expected sign, it is nevertheless not significant.

Like in the case of the money multiplier and the determinants, these results were obtained when the step dummies were allowed for in the modelling process. The relevance of these dummies in the money demand functions is not clear, since most of the major shocks are likely to be reflected in the real income. The result of estimating without the dummy variables showed that the function is still stable. The adjustment

coefficient of about 0.6 obtained when no dummies were used is slightly higher, while a short-run income elasticity of about 0.5 is slightly lower. The long-run elasticity of real income value of about 1.44 is not very different from those obtained when the step dummies were used.

The short-comings of the partial adjustment specification of the money demand function are well documented. For example, it assumes the same adjustment coefficients for disturbances emanating from different sources. This may cast some doubts on the results obtained from the partial adjustment specification of the money demand function. Checking the robustness of these results requires estimating other specifications of the money demand function. One of the specifications estimated is that suggested by David Hendry, using variables in levels and changes. In this case, the short-run coefficients are read off directly from the change variables, while the long-run coefficients are obtained when the level coefficients are divided by minus the coefficient of the lagged dependent variable. The result obtained from this specification showed that the Nigerian money demand function is stable. Most interestingly, the short-run and the long-run elasticities are quite similar to the ones obtained by using the partial adjustment specification. This seems to suggest that the partial adjustment specification may in fact be an adequate representation of the money demand function in Nigeria. This is true only when the shock dummies were allowed for in the modelling process. Without the step dummies, the models are still stable, but the long-run income elasticities of about 1.80 is higher than the value of about 1.40 given by the partial adjustment specification.

The third specification estimated is that of error-correction and cointegration. In this type of specification, an error-correction term is incorporated into the model to cater for movements away from the steady-state relationship between the variables. The results from this equation also indicates that a stable money demand function for Nigeria can be obtained. Further, the short-run income elasticities of money demand obtained are quite close to the ones arrived at by estimating the other functions. The error-correction

specification requires that cointegration should exist between the variables. Without the step dummies it was discovered that cointegration could not be established. This specification can not therefore, be estimated without the step dummies.

All three different specifications with the step dummies and two without the dummies indicate that the money demand function for Nigeria is stable. However, in all the specifications, the interest rate variable, although of the correct sign, is found to be insignificant. The interest rate variable utilised is the treasury bills rate. Two other interest rate variables - the discount rate and the deposit or savings rate not only have statistically insignificant coefficients, but signs which are inconsistent with the theory. Since the interest rate is the only control variable that can be used by the monetary authorities to change the money demand, the above result seems to suggest that the monetary authorities would not be able to change the money demand significantly. The interest rate variable may have been insignificant because, being pegged by the authorities, its year to year variability may not have been enough to be estimated precisely in a regression analysis. In a standard money demand analysis for developing countries, other proxies, besides the interest rate, are often used to represent the opportunity cost of holding money. The most commonly used one is the expected inflation rate. The use of this variable is not expected to be of any benefit in this study, in that it cannot be used as a control variable to alter the quantity of money demanded. Moreover, there is always a great difficulty in defining exactly what an expected inflation variable is. Other proxies utilised include a credit restraint variable. This is expected to be relevant when direct credit control is used as a tool of monetary policy. The theory of endogenous money supply accepts that direct credit control could be effective but its effect is directly on the money stock and not through the money demand. A reasonable conclusion is that the monetary authorities in Nigeria, despite the fact that the money demand function is stable, cannot significantly alter the quantity demanded when the interest rate is used as the control variable.

The first four chapters concentrate on a closed economy analysis. Chapters 5 and 6 take up the issue of the edogeneity of the monetary base in the context of an open economy. Utilising the assets side of the central bank's balance sheet, the monetary base can be defined as the sum of the central bank's net domestic assets and net foreign assets. The net domestic assets is made up of the central bank's credit to the central government, and other domestic private and public institutions. The main item in the foreign assets is the foreign exchange reserves. Central banks can only attempt to change the monetary base through the domestic component (domestic assets). The foreign component of the monetary base is determined by external factors e.g imports/exports, capital movements, etc.. However, in a small open economy under a fixed exchange rate regime, any change in the domestic component of the monetary base is likely to be offset by an opposite change in the foreign component. Implying that the central bank may not be able to effect a sustaining change on the monetary base. Offset to the domestic component of the monetary base by the foreign component is often analysed in the context of the monetary approach to the balance of payments theory.

A detailed analysis of the monetary approach to the balance of payments theory and how the offset to the domestic component of the monetary base is measured, is carried out in chapter 5. According to this theory, an increase (decrease) in the domestic component is offset by a decrease (increase) of the same magnitude in the foreign component, such that the monetary base remains at the initial level. Assuming the following: countries do not sterilise balance of payments deficits and surpluses, domestic income, prices, and interest rates are exogenous in the long-run, and countries operate a fixed exchange rate regime, an equation commonly known as "the reserves flow equation" is used to test the offset proposition empirically. The reserves flow equation, derived from the money market equilibrium condition, defines the change in the net foreign assets of the central bank as a function of change in the net domestic assets, change in the domestic real income, domestic prices, domestic interest rates, and the

money multiplier. The estimated coefficient of the net domestic assets is known as the the offset coefficient. An offset coefficient value of minus one is taken to indicate that offset to the domestic component of the monetary base is complete and therefore, the monetary base cannot be changed. The non sterilisation assumption is very important to the above conclusion. To assume otherwise means that the initial offset can be undone, for example, by a continuous increase in the domestic component of the monetary base, thus enabling a sustaining increase in the monetary base. An empirical test for the degree of sterilisation is carried out by estimating an equation known as the monetary policy reaction function, which defines the domestic component of the monetary base as a function of the foreign component and other variables that determine the monetary policy decisions of a country. In a similar manner to the reserves flow equation, the estimated coefficient of the foreign component of the monetary base is called the sterilisation coefficient. A value of minus one is taken to indicate that a complete sterilisation of payments deficits and surpluses is practiced, and as such change in the monetary base can be sustained.

The reserve flow equation has been criticised because, firstly it is derived from the money market conditions alone to the exclusion of the other sectors of the economy, and secondly it measures the offset in the long-run, while the short-run may be more important. These conditions can be remedied by deriving the offset coefficient in the context of a macro-model where domestic income, prices, and interest rates are allowed to change.

In chapter 6, for the purpose of testing to see whether the domestic component of the Nigerian monetary base is offset by the foreign component, the reserve flow equation, a quasi reduced form - behavioural equation from a macro-model, and a monetary policy reaction function are estimated using Nigerian data. The results from the reserves flow equation showed that the offset coefficient is equal to minus one, tentatively suggesting that the monetary base is endogenous in the long-run and cannot be controlled by the

Central Bank of Nigeria for monetary policy purposes. The reduced form equation estimated using the error-correction and cointegration technique, gave an offset coefficient of about -0.85. This value is almost equal to minus one, indicating that even in the short-run, when domestic variables are allowed to change, the offset to the domestic component of the monetary base is still complete.

Estimating the monetary policy reaction function gave a sterilisation coefficient value of -0.77. This indicates that over 70 percent of the offset to the domestic component of the monetary base in Nigeria has been sterilised in the past. The implication of this is that, as far as the offset to the domestic component of the monetary base is concerned, Nigeria could have a sustained change in its monetary base. However, it is important to bear in mind that a continuous sterilisation of payments deficits and surpluses is not possible because the country has a limited amount of foreign exchange reserves and government securities. Furthermore, evidence showed that Nigeria only sterilised deficits and not surpluses. A continuous sterilisation of payments surplus implies a continuous decline in the Government expenditures; a position not tenable in a developing country with a large public sector like Nigeria. In addition, the classic problem of simultaneity inherent in this type of analyses is likely to lead to a biased estimates of the coefficients. Therefore, the over 70 percent sterilisation given by the monetary policy reaction function may not represent the actual degree of sterilisation undertaken in Nigeria.

Summing up, this study suggests that the Nigerian Monetary Authorities have a very limited scope for an effective independent monetary policy carried out in the traditional way. In effect, one may say that, as far as monetary policy independence is concerned, Nigeria does not stand to lose much by surrendering it to an ECOWAS-wide body. This conclusion, to a large extent, also applies to the other member countries of ECOWAS, and especially to the member countries of the West African Monetary Union (WAMU) who have had a single currency and a single central bank for over 25 years.

Appendix I

Definitions of Variables and the Description of Data used in the Estimations

All data utilised in this study are for the period covering 1960 to 1989.

GDP: Annual Values of Real Gross Domestic Product - from IMF International Financial Statistics Year Book, 1990 Country Page line 99b.p

P: Gross Domestic Product (GDP) Deflator 1985 = 100 - from IMF International Financial Statistics Year Book, 1990 Country Page line 99bip

C_p: Currency with the non-bank public - from IMF International Financial Statistics Year Book, 1990 Country Page line 14a.

R: Reserves of the commercial banks - from IMF International Financial Statistics Year Book, 1990 Country Page (line 14 minus 14a plus the end of period Treasury Bills held by the commercial banks.

CPI: Consumer Price Index 1985 = 100 - from IMF International Financial Statistics Year Book, 1990 Country Page line 64.

LRT: Period Average of the Commercial banks' lending rate - from IMF International Financial Statistics Year Book, 1990 Country Page line 60P.

SRT: The Period Average of the Rates Offered to Resident Customers for Savings/Deposits - from IMF International Financial Statistics Year Book, 1990 Country Page line 60I.

DRT: The end of period rate at which the Central Bank of Nigeria lends or discounts eligible papers - from IMF International Financial Statistics Year Book, 1990 Country Page line 60.

DD: The end of period value of the Demand Deposits with the commercial banks, net of the Federal Government's deposits - from IMF International Financial Statistics Year Book, 1990 Country Page line 24.

TD/SD: The end of period values of the Time plus Savings Deposits with the commercial banks - from IMF International Financial Statistics Year Book, 1990 Country Page line 25.

M1: Nominal Narrow Money (C_p + DD) - from IMF International Financial Statistics Year Book, 1990 Country Page line 34.

M2: Nominal Broad Money (C_p + DD + TD/SD) - from IMF International Financial Statistics Year Book, 1990 Country Page line 35I.

DC: Domestic Credit (the sum of end of period net claims on the Federal Government, claims on the private sector and claims on other financial institutions - from IMF International Financial Statistics Year Book, 1990 Country Page line 32.

H: Monetary Base (R + C_p)

U: Money Multiplier (M/H)

NDA: Net Domestic Assets of the Central Bank, made up of the Central Bank's claims on the Federal Government and other domestic institutions - from IMF International Financial Statistics Year Book, 1990 Country Page lines (12a + 12d + 12e + 12f - 16b -16d - 17a - 17r)

E: The end of period Nominal Exchange rate, defined as the amount of US dollars one unit of Nigerian naira commands - from IMF International

Financial Statistics Year Book, 1990 Country Page line ag.

NFA: Net Foreign Assets of the Central Bank - from IMF International Financial Statistics Year Book, 1990 Country Page lines (11 - 16c)

BBRCH: Number of bank branches at the end of each year - from various issues of Central Bank of Nigerian (CBN) Annual Reports and Statements of Account.

TBR: The period average Treasury Bills rate - from various issues of Central Bank of Nigeria (CBN) Economic and Financial Review.

Y*: Foreign income, calculated as a weighted average of the real GDP in US dollars of the following countries: US, France, Germany, Italy, Netherlands, Spain, and Japan. The weights are the percentages of Nigeria's exports to each of the countries in 1985.

P*: Foreign prices - Weighted GDP deflators of the countries mentioned for Y*, where the weights are the percentage of Nigeria's imports from each one of the countries in 1985.

i*: Foreign Interest Rate (the period average of Eurodollar rate in London) - from IMF International Financial Statistics Year Book, 1990 country page (United Kingdom) line 60d.

G: The end of period nominal values of Government expenditures deflated by the GDP delator - from various issues of CBN Economic and Financial Reviews

DBBT: Federal Government domestic debt outstanding at the end of each year -

from various issues of CBN Economic and Financial Reviews

EDBT: Government and Government guaranteed external debts outstanding at the end of each year - from various issues of World Debt Tables and World Bank World Tables.

PI: Imports Price Index, cif 1985 = 100 - from various issues of the World Bank World Tables.

PX: Exports Price Index, fob 1985 = 100 - from various issues of the World Bank World Tables.

DUMMIES D1967/68: ones until 1968 and then zeros for the rest of years

D1970/71: ones until 1971 and then zeros for the rest of years

D1973/74: ones until 1974 and then zeros for the rest of years

D1981/82: ones until 1982 and then zeros for the rest of years

D1985/86: ones until 1985 and then zeros for the rest of years

DCW: ones for the civil war period (1967, 1968, and 1969) and ones for the rest of period.

Appendix II

Some Basic ECOWAS Statistics

Table A2.1
Some Basic Statistics
For the ECOWAS Countries

Countries	GDP mills $US		Pop. mills		Working Pop. as a % of Total		GDP Percapita		Sectoral Contribution to GDP as a % of Total**								Area 000's sq. km.
									Agric		Indust		Manufac		Services		
	1985	1988	1985	1988	1985	1988	1985	1988	1985	1988	1985	1988	1985	1988	1985	1988	
Benin	960	1710	4.0	4.4	49	50	240	389	48	40	16	13	4	6	36	47	113
Burkina Faso	930	1750	7.9	8.5	44	51.9	118	206	45	39	22	23	-	13	33	38	274
Cape Verde	114	280	0.33	0.35			348	796									
Cote D'Ivore	5220	7650	10.1	11.2	54	49	517	683	36	36	26	25	17	16	38	39	322
The Gambia	172	189	0.75	0.82			230	230									
Ghana	4860	5230	12.7	14	48	50.2	383	374	41	49	15	16	11	10	43	34	239
Guinea	1980	2540	5.4	6.2	52	54.3	319	470	40	30	22	32	2	5	38	38	246
Guinea Bissau	158	135	0.89	0.94			178	143									
Liberia	1000	990	2.2	2.4	52	51.5	455	413	37	37	28	28	5	5	36	35	111
Mali	1100	1940	7.5	8.0	50	50.5	147	242	50	49	13	12	7	5	37	39	1240
Mauri-tania	600	900	1.7	1.9	53	52.6	353	474	29	38	25	21	-	-	47	41	1026
Niger	1580	2400	6.4	7.3	51	50.5	247	329	47	36	16	23	4	9	37	32	1267
Nigeria	75300	29370	99.7	110.1	49	49.4	755	267	36	34	32	36	9	18	32	29	924
Senegal	2560	4980	6.6	7.0	52	50.5	388	711	19	22	29	18	19	52	49	197	
Siera Leone	1190	1270	3.7	3.9	55	54	322	326	44	46	14	12	6	3	42	42	72
Togo	700	1360	3.0	3.4	50	49.3	233	400	30	34	24	21	7	8	47	45	57

Sources: World Bank World Development Report (various issues)
World Bank World Tables (various issues)
** Agric covers: Agriculture, Forestry, Hunting and Fishing
Industry covers: manufacturing, mining, construction, Electricity, Water and Gass
Services cover: All other sectors of the economy

Table A2.2
Imorts and Exports Matrix for ECOWAS
Millions of $US in 1988

Mij → / Xij ↓	Benin	Burkina Faso	Cape Verde	Cote D'Ivoire	Gambia	Ghana	Guinea	Guinea Bissau	Liberia	Mali	Mauritania	Niger	Nigeria	Senegal	Siera Leone	Togo	Imports		
																	ECOWAS Counts.	Indust Counts.	Total
Benin		0.35		19.9		0.8					0.59	1.08	1.0	3.69		1.62	29.03	253.4	473.99
Burkina Faso	0.04			117.4		0.2				3.82	0.18	1.62		2.84		3.10	129.20	240.95	424.02
Cape Verde				1:2										0.01			1.21	77.85	95.58
Cote D'Ivoire	0.67	2.60				1.0				9.26	22.45	2.40	123.00	19.12	0.49	0.62	181.61	1333.89	1990.17
Gambia						0.1		0.04			0.01			4.29	0.11		4.55	127.45	189.91
Ghana	0.01	4.42		19.1	0.23								109.00	0.06		37.32	170.44	717.84	931.32
Guinea					4.23	0.1		0.03	0.5					6.33	0.02	0.20	11.41	336.72	390.72
Ginea Bissau					0.15		0.08							4.14			4.37	64.92	86.96
Liberia				18.3	0.02		0.39			1.53	2.10		2.0	0.91	1.14	0.13	26.52	1274.58	2084.22
Mali	0.01	0.84		116.9			10.60				0.07	1.77		24.25		1.46	155.90	268.82	445.91
Mauritania				0.4						0.09				18.15			18.64	307.35	402.19
Niger	5.11	1.61		32.4						0.14			5.0	0.51		3.96	48.73	235.95	343.31
Nigeria	3.60	3.69		14.3	0.01	1.6		0.11	8.60	0.26	1.59	15.12		2.77	0.01	1.66	53.32	3431.70	4658.40
Senegal				55.7	0.01	0.9	0.07	0.4	0.1	0.50	1.31	0.71	43.00		0.14	0.01	102.49	641.70	971.69
Siera Leone	0.12			0.5	0.01		0.06		0.9				52.00	0.85			54.44	73.96	140.25
Togo	1.12	0.86		33.0		35.9	o.25		0.5	0.58	3.47	0.65		1.59			77.92	388.26	643.70
To ECOWAS	10.68	14.37		429.1	4.66	40.7	11.45	0.21	10.8	16.18	31.77	23.35	335.00	89.51	1.91	50.08			
To Indst. Countries	53.32	89.92	3.1	2051.10	86.10	773.10	419.66	6.76	839.6	73.84	350.14	334.09	6606.00	349.20	69.57	194.14			
Total Exports	71.05	154.58	6.70	3107.10	96.27	1075.30	476.99	9.71	883.50	172.40	507.62	359.96	7638.00	591.19	106.45	329.37			

Sources: IMF Direction Trade Statistics Year Book 1988
Xij: Exports of Country i to j
Mij: Imports of Country i from j
Imports are Excluding c.i.f.

Table A2.3
Exports of the ECOWAS Countries
Percentage of Total 1988

	Benin	Burkina Faso	Cape Verde	Cote D'Ivoire	Gam-bia	Ghana	Guinea	Guinea Bissau	Libe ria	Mali	Mauri-tania	Niger	Nige-ria	Sene gal	Sierra Leone	Togo
Benin		0.23		0.64		0.07					0.12	0.30	0.01	0.62		0.49
Burkina Faso	0.06			3.78		0.02				2.22	0.04	0.45		0.48		0.94
Cape Verde				0.04												
Cote D'Ivore	0.94	1.68				0.09				5.37	4.42	0.67	1.61	3.23	0.46	0.19
The Gambia						0.01		0.44					0.73	0.10		2.40
Ghana	0.01	2.86		0.61	0.24				0.02				1.43	0.01		11.33
Guinea					4.39	0.01		0.29	0.06					1.07	0.02	0.06
Guinea Bissau					0.16	0.01	0.02							0.70		
Liberia				0.59	0.02		0.08			0.89	0.41		0.03	0.15	1.07	0.04
Mali	0.01	0.54		3.76			2.22				0.01	0.49		4.10		0.44
Mauri-tania				0.1						0.05				3.07		
Niger	7.20	1.04		1.04						0.08			0.07	0.09		1.20
Nigeria	5.07	2.39		0.46	0.01	0.15		1.08	0.97	0.15	0.31	4.20		0.47	0.01	0.50
Senegal				1.80	0.01	0.08	0.01	0.38	0.01	0.29	0.26	0.20	0.56		0.13	
Siera Leone	0.17			0.02	0.01		0.01		0.10				0.68	0.14		
Togo	1.58	0.56		1.06		3.34	0.05		0.6	0.34	0.68	0.18		0.27		
To Ecowas	15.03	9.03		13.81	4.84	3.78	2.40	2.16	1.22	9.39	6.26	6.49	4.39	15.14	1.79	15.20
To Indust.	75.05	58.17	46.30	66.01	89.44	71.90	88.0	69.55	94.96	42.83	68.98	92.81	86.49	59.07	65.35	58.94

Calcualted from IMF IFS Direction of Trade Year Book

Table A2.4
Imorts and Exports Matrix for ECOWAS
Millions of $US in 1990

Mij → / Xij ↓	Benin	Burkina Faso	Cape Verde	Cote D'Ivoire	Gambia	Ghana	Guinea	Guinea Bissau	Liberia	Mali	Mauritania	Niger	Nigeria	Senegal	Siera Leone	Togo	Imports		
																	ECOWAS Counts.	Indust Counts.	Total
Benin		0.44		25.20		1.0			0.04		0.16	1.36	2.0	4.67		2.05	36.92	251.122	441.15
Burkina Faso	0.05			148.50		0.2				4.83	0.01	2.05	0.02	3.59		3.92	163.17	267.80	491.30
Cape Verde				2.1							0.03			0.04			2.17	106.29	125.91
Cote D'Ivoire	0.85	3.29				1.2				11.71	33.66	3.03	147.00	24.19	0.67	0.78	226.38	1239.66	1992.69
Gambia						0.1		0.05			0.01		0.01	5.43	0.15		5.75	109.55	184.02
Ghana	0.02	5.60		24.20	0.36						0.45		131.00	0.08		47.21	209.22	923.31	1248.84
Guinea					6.69	0.09		0.04	0.7		0.04		0.05	8.10	0.03	0.26	15.99	384.14	455.18
Ginea Bissau			0.2		0.23		0.10							5.24			5.77	81.25	105.77
Liberia	0.01			23.20	0.3	0.1	0.49			1.94	5.38		2.0	1.15	1.54	0.17	36.01	2571.30	4044.87
Mali	0.02	1.06		147.90		0.1	13.41		0.01		0.08	2.23		30.68		1.84	197.33	280.61	504.81
Mauritania				0.6		0.01				0.05		0.04		2.11			2.81	382.90	491.50
Niger	6.47	2.03		41.00		0.01				0.17			6.0	0.64		5.01	61.33	211.19	341.98
Nigeria	3.54	3.63		14.30	0.01	1.2		0.10	6.80	0.26		14.89		2.10	0.01	1.63	48.47	4136.40	5493.60
Senegal	0.15		0.01	70.50	0.02	1.20	0.09	0.05	0.1	0.64	0.54	0.90	43.00		0.19	0.02	117.41	911.53	1282.37
Siera Leone				0.6	0.01		0.06		0.6		0.03		51.0	0.62			52.92	113.02	185.79
Togo	1.42	1.08		41.70		45.4	0.32		0.6	0.71	1.47	0.83	0.20	2.01			95.77	460.39	688.57
To ECOWAS	12.53	17.13	0.21	539.80	7.62	50.60	14.48	0.24	9.15	20.34	41.86	25.33	382.28	90.65	2.59	62.89			
To Indst. Countries	59.74	92.15	3.8	2163.90	125.68	1043.50	499.33	6.55	1697.5	113.77	348.48	235.54	11628	439.49	127.31	143.66			
Total Exports	92.54	157.11	8.40	3511.40	168.27	1365.90	592.46	7.6	1845.60	270.06	486.65	265.05	12669.00	675.84	180.29	296.26			

Sources: IMF Direction Trade Statistics Year Book 1990
Xij: Exports of Country i to j
Mij: Imports of Country i from j
Imports are Excluding c.i.f.

Table A2.5
Exports of the ECOWAS Countries
Percentage of Total 1990

	Benin	Burki Faso	Cape Verde	Cote D'Ivoire	Gam-bia	Ghana	Guinea	Guinea Bissau	Libe-ria	Mali	Mauri-tania	Niger	Nige-ria	Sene-gal	Sierra Leone	Togo
Benin		0.28		0.72		0.07			0.00		0.03	0.51	0.02	0.70		0.70
Burkina Faso	0.05			4.23		0.02				1.80	0.00	0.78		0.53		1.32
Cape Verde			0.06							0.01			0.01			
Cote D'Ivore	0.92	2.09				0.09			4.34	6.92	1.14	1.16	3.58	0.37	0.26	
The Gambia						0.01		0.71			0.00			0.80	0.08	
Ghana	0.02	3.56		0.69	0.21				0.02		0.09		1.03	0.01		15.96
Guinea					3.98	0.01		0.47	0.04		0.01			1.20	0.02	0.09
Guinea Bissau			2.38		0.14		0.02							0.78		
Liberia	0.01			0.66	0.18	0.01	0.08			0.72	1.12		0.02	0.17	0.85	0.06
Mali	0.02	0.67		4.21		0.01	2.26		0.00		0.02	0.84		4.54		0.62
Mauri-tania				0.02			0.00			0.2		0.02		0.31		
Niger	6.99	1.29		1.17		0.00				0.06			0.05	0.10		1.69
Nigeria	3.83	2.31		0.41	0.00	0.09		1.34	0.37	0.10		5.62		0.31	0.01	0.55
Senegal	0.16		0.01	2.0	0.01	0.09	0.02	0.62	0.01	0.24	0.11	0.34	0.33		0.11	0.01
Siera Leone				0.02	0.01		0.01		0.033		0.01		0.4	0.09		
Togo	1.53	0.69		1.19		3.32	0.05		0.03	0.27	0.30	0.31	0.00	0.30		
To Ecowas	113.54	10.90	2.47	15.37	4.53	3.70	2.44	3.16	0.50	7.53	8.60	9.56	3.02	13.2	13.32	1.44
To Indust.	64.56	58.65	45.24	61.62	74.69	76.40	84.28	86.18	91.97	42.13	71.61	88.87	91.78	65.03	70.61	48.49

Calcualted from IMF IFS Direction of Trade Year Book

Table A2.6
Principal Exports of Some ECOWAS Countires
as a % of Total Export

COUNTRIES	PRODUCTS	1975	1980	1985
BENIN	Palm products	19.28	27.78	-
	Cotton	22.71	18.52	-
	Cocoa	9.45	22.13	-
BURKINA FASO	Cotton	16.27	43.89	37.42
	Live animals	36.10	23.67	10.90
COTE D'IVOIRE	Coffee	24.24	20.50	21.07
	Cocoa	18.71	25.24	30.33
	Wood	13.68	15.09	4.40
THE GAMBIA	Groundnut Products	93.31	54.23	19.77
GHANA	Wood	9.02	2.67	3.42
	Cocoa	59.89	74.14	55.21
LIBERIA	Iron Ore	74.55	51.68	64.14
	Diamond	4.67	5.57	1.07
	Rubber	11.74	17.04	17.71
MALI	Cotton	37.88	47.33	41.47
	Live Animals	12.54	28.98	25.92
MAURITANIA	Fish	9.20	22.03	59.71
	Iron Ore	82.28	77.70	40.23
NIGER	Uranium	60.76	84.34	78.89
	Live animals	18.68	5.46	11.61
NIGERIA	Crude oil	94.01	96.09	97.11
	Cocoa	3.7	-	-
SENEGAL	Petro. Products	7.10	18.78	15.59
	Fish & Shellfish	3.74	13.80	10.20
	Phosphate	22.43	16.34	9.32
	Groundnuts	32.55	13.27	14.49
SIERA LEONE	Bauxite	2.40	5.25	17.38
	Coffee	5.87	13.20	2.61
	Diamond	56.79	58.87	18.79
	Cocoa	6.00	10.98	7.77
TOGO	Phosphate	61.47	39.57	50.15
	Coffee	6.54	7.00	13.93
	Cocoa	17.43	11.48	8.01

Sources: IFS Supplements On Trade Statistics

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