MONEY AND THE BALANCE OF PAYMENTS IN AN OIL PRODUCING COUNTRY, THE CASE OF LIBYA

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CHAPTER I

INTRODUCTION

Statement of the Problem

Most of the oil producing countries, such as the OPEC members, depend principally on oil revenue for generating their economic development. Oil revenue is by far the principal source of gaining foreign exchange which finance imports of goods and services and hence economic development in general.

In the case of Libya, oil exports amount to 99.9% of total exports which means that Libyan foreign assets are earned only from oil exports. Since Libyan currency issued is 100% backed by gold, foreign exchange, and government treasury bills, the issue of currency in circulation responds automatically to changes in the central bank liabilities such as the government deposits which are the only source of foreign exchange to the Central Bank of Libya. That is to say, when the government receives oil revenue from the oil companies, the amount of this check is deposited at the Central Bank in the government accounts, which means that the foreign exchange of the Central Bank is also increased by the same amount. However, most payments come through commercial banks with which oil companies hold their deposits, so foreign exchanges are received firstly by commercial banks, but these foreign exchanges are sold to the Central Bank, since commercial banks are permitted only to keep a certain maximum level (predetermined) for their transactions abroad. The money market in Libya is limited to regular banking activities; there are no security markets or other developed financial intermediaries. The money supply is affected permanently only when the government starts spending its oil revenue such as spendings become incomes to individuals and corporations and hence these incomes generate more income through the economic activities in general. Net changes in government deposits at the Central Bank represents the net government spending in the economy.

The availability of foreign exchange encourages demanders for currency, mainly government, to withdraw more cash and inject it in the Libyan economy. Currency in circulation constitutes more than half of the money supply (narrowly defined). The other component of money, which is demand deposits, are mostly owned by the commercial sector and businessmen and mostly created by the extension of credits from commercial banks to finance imports and other development projects. It is true that credit creation increases money supply and the latter leads to increase the price level. But in the case of Libya, credit creation is mostly devoted to finance imports which increase the supply of foreign goods in the domestic market, and hence decrease the price level. However, the net effect of credit creation may be very small since most credits are granted to finance imports of goods and services. The pressure of government expenditure on economic development makes the monetary authority unable to regulate credits and hence money supply created by commercial banks. But the increase in money supply is partly absorbed by the increase in imports, which lead to reduce the level of foreign reserves. So money supply in Libya can be related to the surplus or deficit of the balance of payments. Thus, the supply of money is not directly controlled by the monetary authority; it is endogenous as a result of the feedback from the balance of payments through changes in net foreign assets.

Since such an oil producing country is characterized by a surplus in its balance of payments, and plenty of foreign exchange reserves, it was said by higher government officers that money supply has no influence on prices and output. However, Harry Johnson's new approach to the balance-of-payments theory concentrates not on relative price changes but on the direct effect of excess money demand or money supply on the balance between income and expenditure (37, 148). So the concern of this dissertation is with the problem of whether the money supply can influence prices and output in Libya on one hand and its influence on the balance between income and expenditure on the other. Here income is considered as net income from oil and expenditure as those spendings on foreign goods and services plus capital outflow from residents. That is, since receipts by residents from residents equal payments by residents to residents, according to the absorption approach to the balance of payments, it is likely to consider only the receipts from and payments to the foreign sector. That is, B = R - P; where R is total receipts, P is total payments, and B is the deficit or surplus in the balance of payments. Therefore, $B = (R - R_r) - (P - P_r) = R_F - P_F$; where r denotes resident and F denotes foreign.

Thus it is likely that the study of money demand and supply function in Libya is to be linked to changes in the balance of payments such as: a change in the foreign assets (net) will partly finance imports of goods and services, and the other part will finance the capital outflow (net) if money supply is kept constant. Otherwise, money supply rises (or falls) when there is a surplus (or deficit) in the balance of payments.

The analysis by period is also considered, because there is a big revolutionary change in the economic system of the country from a conventional one during the first period (1962 - September 1969) to a growing socialistic economic system during the second period (September 1969 - 1977). Each period may have different estimates for each function of the whole model and show the relevant independent variables for each function. Therefore if there is a change in the structure of the economic behavior of the Libyan people, or a shift in the functions, the analysis by period may capture the structural change and the shift in the Libyan economy. That is, a new information may be obtained from these periods analysis, showing the economic behavior development of the Libyan people during these two periods.

Motives of the Study

The purpose of this study is:

1. To construct a monetary econometric model linked to the main changes in the balance of payments such as: net surplus in the oil sector which represents net income of foreign exchange and outflow of funds in non-oil sector which represents expenditures on imports of goods and services and capital outflow.

2. To investigate the influence of money supply on prices and output on one hand and on the balance of income and expenditure through the balance-of-payments on the other.

3. To estimate the model using both annual data 1962-1977 and quarterly data from 1962-1 to 1977-4 in Libya, and to estimate the model, and to test its validity.

4. To investigate the model's properties including its stability, predictive ability and the role of money in economic activity, so some implications for monetary stabilization policies can be drawn.

Organization of the Study

This study contains nine chapters. In outline form, they are:

I. Introduction, statement of the problem, motives and organization of the study.

II. (A) Theoretical background of the main approaches of demand for and supply of money functions.

(B) Theoretical background of links between monetary sector and the foreign sector.

III. The structure of the Libyan economy

IV. The Model. This chapter promotes the monetary econometric model which incorporates interactions between monetary aggregates demand and supply, real sector variables, and the main items of the Libyan balance of payments.

V. Ordinary least squares (OLS) estimation of money demand function and testing its validity

VI. Ordinary least squares (OLS) estimation of the rest of the model and testing its validity

VII. Two stage least squares estimation of the model (2SLS)

VIII. Simulation and validation including discussion on stability and dynamic multipliers, and to conduct a number of simulation experiments in order to investigate the properties of the model including stability, predictive ability and the role of money

IX. Conclusions and summary.

CHAPTER II

THEORETICAL BACKGROUND

Demand for Money

A great deal of attention has been given to the development of monetary theory, both past and recent times. Some economists explained the demand for money by analyzing the motives that prompt people to hold money, such as Keynes (60) and other Cantabridgeans. Other economists considered the demand for money as an application of the general theory of demand for capital which is based on utility theory. According to this view, people hold money in the same way as they hold durable goods [Friedman (41); Klein (63)]. That is, the demand for money function considered money to be a durable good yielding a flow of utility services. Friedman interpreted money as a durable good held for the services it rendered. Keynes developed two parts of demand for money: the first part is what he called (L1) the transactions and precautionary demand for money, and the second part is what he called (L2) the speculative demand for money. He considered the former as proportional to income, while the demand for L2 was considered as negatively related to the nominal interest rate. However, the great contribution of the Keynesian work in the monetary theory development was his attempt to replace the classical view of a constant velocity determined by institutional factors, by a theory of demand for money as an asset alternative to other interest-bearing assets such as bonds.

Then in the 1950's, a transactions demand for money approach was developed by two independent studies[1]: Baumol (7) and Tobin (103). The Baumol transaction demand approach is considered by Johnson (58) to be a significant contribution in the sense that the theory of demand for money is integrated into a generalized capital-theory approach to demand for money, treating cash as a form of inventory held for the services it yields. It is interesting to note also that in the inventory approach to transaction demand, nothing was said about the utility of holding money for transaction purposes[2]. However these theories of the demand for money, whether they are based on the general theory of demand or they are based on the usefulness of money in making transactions, could be regarded as all forming part of one general theory of the demand for money. Laidler (70, p. 54) indicated "it is convenient to treat them as alternative and then as how much of the variation in the demand for money is to be explained solely by the factors that each particular hypothesis suggests are important".

Thus, it may be useful to discuss in detail one example in each approach: the asset demand for money or the utility approach and the

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[1]Tobin indicated that he had not read Baumol's paper before writing his. However, Baumol is interested in the implications of his analysis for the theory of transactions velocity of money at given interest rate, while Tobin is interested in supporting and elaborating Hansen's argument, that is "even transactions balances will become interest-elastic at high enough interest rates" (99, p. 241), therefore Tobin's paper concentrates on the interest-elasticity of the demand for cash at a given volume of transactions.

[2]Patinkin (89, p. 570) criticizes Walrus for not giving an economic rationale for including money in the utility function. Patinkin (88, p. 54) also cites the work of Baumol and Tobin as examples of explaining demand for money without assigning a direct utility to money.

transactions demand for money or the inventory approach.

The Utility Approach of Demand for Money

It may be preferable to start with Samuelson's (95, p. 117-122) formulation that represents the view of classical and neoclassical monetary theory, and which is developed in his Foundations. He considers only the demand for money holdings by the consumer; therefore ordinal utility or preference depends upon all commodities.

In fact neither Keynes (60) nor Friedman (40) formally state the utility function and the constraint to be used, but there is some analysis that demand for money may be treated as the solution of maximizing a utility function subject to the total wealth constraint, as in the Friedman's analysis in his restatement of the quantity theory of money, and subject to the income constraint to the Keynesian analysis of demand for money.

The Keynes and Friedman approaches do not relate the demand for money to the general demand for consumer goods, usually associated with the classical theory, but they are related to demand for earning assets and to the theory of capital, as money is one kind of asset and one way of holding wealth.

However, there does exist a body of work concerning the utility approach which investigates the problem of portfolio selection, as that of Tobin (104). Tobin proved that individual investor tends to diversify a portfolio between money and bonds, and not as Keynes stated that individuals will hold either money or bonds.

Now then according to Klein (61) money is considered empirically to be a durable consumer and producer good[3] which yields unspecified "monetary service" flow. This flow of services is unspecified because what these services consist of is still an unanswered theoretical question. However such services are assumed to enter a utility function, and hence demand for money is derived from the demand for these unspecified services (61, p. 931). Here the Klein model of demand for money is elaborated, because this study has considered a similar model modified in such a way to be appropriate for the case of Libya. Klein assumes there is another financial asset which also yields an alternative "monetary service" flow, therefore the flow of monetary services from money and the other financial asset can be represented by the following production function:

$$N = N\ (M/P,\ S/P,\ \alpha) \tag{1}$$

where N is the flow of real monetary services yielded per unit of time, (M/P) is the stock of real balances held by the individual, (S/P) is the real stock of the financial asset (money substitute) held, and α represents all other possible variables that may influence (N) which are assumed to remain constant.

The marginal productivities of both money and other financial

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[3]The idea of considering money as a producer good may have arose from the fact that the neoclassical production function is concerned with the structural relationship between real inputs and real production, bearing in mind that money is used to obtain real inputs, and hence it is reasonable to include real money as a factor input that contributes to the level of production in the economy. Empirical evidence is found in Short (96) and Sinia and Houston (97), which support the hypothesis that money is a productive asset that belongs in the production function (for more details see Patinkin's book (89, Chapter VII)). However, the theoretical validity of including real money balances as a factor input is still under debate and unresolved.

assets are assumed to be decreasing, so that the conditions for maximizing the flow of monetary services are the equality of the marginal product of each asset with its own price. Klein assumes also that all other non-monetary services are represented by a vector (X), so that a utility function is written in the form

$$U = U\ (X,\ N) \tag{2}$$

where X is the rate of consumption of non-monetary services and N is the rate of consumption of the monetary services. Then X is considered a function of the rate of net real income received:

$$X = [PYo + rmM + rsS + iB]\left(\frac{1}{P}\right) \tag{3}$$

where the term in brackets is the individual's money income, Yo is the real rate of permanent earnings from commodity services or the human wealth; rm and rs are assumed to be the marginal pecuniary interest rate yielded by money and money substitute, respectively; while the new added term (B) denotes bonds which yields only a pecuniary interest rate equal to (i). That is, bonds are other financial assets which yield no monetary services. M, S, and B denote the nominal non-human wealth which is in terms of money, so that the total real non-human wealth (Wo) given to the individual is:

$$Wo = M/P + S/P + B/P \tag{4}$$

or

$$B = P.Wo - M - S \tag{5}$$

Now assuming the market interest yield i and the rental price of commodity services P are constant, then the individual can maximize utility subject to (Yo, Wo) and to the budget constraint that all his income is spent. Thus from (1), (2), (3) and (5) the following Lagrangian can be formed:

$$V = U[X, N(M/P, S/P, \alpha)] - \lambda[PX - PYo - rmM - rsS - i(PWo - M - S)]$$

Now differentiating with respect to the individual decision concerning the flows of services from X, M and S, the following necessary conditions for maximizing these flows are:

$$\frac{\partial V}{\partial X} = U_1 - \lambda P = 0 \qquad (6)$$

$$\frac{\partial V}{\partial M} = U_2 N_1 \; (1/P) + \lambda rm - \lambda i = 0 \qquad (7)$$

$$\frac{\partial V}{\partial S} = U_2 N_2 \; (1/P) + \lambda rs - \lambda i = 0 \qquad (8)$$

Now as the second order conditions are assumed to hold, then the optimum quantity of X, M and S are obtained when the marginal utility of a dollar of income spent on each flow of services must be equal, as shown by the following condition:

$$\lambda = \frac{U_1}{P} = \frac{U_2 N_1 (1/P)}{(i - rm)} = \frac{U_2 N_2 (1/P)}{(i - rs)} \qquad (9)$$

λ must be interpreted here as the marginal utility of money income, so the marginal utility of each flow of services divided by its price must be the same for these three groups of services. Therefore as P is the rental price of a unit of commodity services, the (i - rm) denoted by (Pm) and (i - rs) denoted by (Ps) may be interpreted as the rental price of the monetary service stream from a unit of money and a unit of monetary substitutes, respectively. That is, Pm is considered the own price of money, while Ps is the cross price of money. Both of these prices can be considered as the marginal pecuniary cost per unit of time of holding a unit of money or money substitute; they must be equal to the value of the marginal monetary services from money or from money substitutes. Thus the conditions (9) of utility maximization imply that the demand for real money balances will be in the form:

$$(M/P)^d = f(YP, Pm, Ps) \qquad (10)$$

where YP is the permanent income as a proxy for Yo and Wo, and the partial derivatives are: $f_1 > 0$, $F_2 < 0$, while $f_3 > 0$ assumed by Klein (61, p. 933) "as long as the substitution in production effect dominates any scale of production effect". In fact a rise in Ps, other things remaining constant, decreases the monetary service flow from money substitution and hence decreases the demand for money, but this rise in Ps will also increase monetary services demanded from money, and hence increase demand for money. Klein has assumed that the second effect is always dominant, since the alternative asset is also assumed to be a substitute for money in the sense of a positive cross partial derivative.

The Transactions Demand for Money: The Inventory Approach

Theoretical work on transactions demand for money has been done by both Baumol (7) and Tobin (103). Baumol applies some common results in inventory theory to be used in deriving the optimum average stock of money holding. He assumes that the economic unit can obtain cash only by selling bonds and that payments are made at a steady rate. Let T stand for total expenditures during a given period, i be the opportunity cost of holding money taken as the rate of interest, C be the amount of cash withdrawn, and b be the broker's fee which must be paid whenever a conversion from bonds to cash or from cash to bonds has occurred. Now assuming (i), (b) and (T) are constant during this given period, then the average cash holding per economic unit is (C/2) and the annual interest cost is i(C/2). The number of withdrawals is (T/C), so that the annual brokerage costs must be b(T/C). Therefore the total cost will be:

$$TC = b\left(\frac{T}{C}\right) + i\left(\frac{C}{2}\right) \qquad (11)$$

Now to get the average of money holdings which minimizes total costs for the transactor, differentiate TC with respect to C and set it equal to zero, as

$$\frac{\partial (TC)}{\partial C} = -\frac{bT}{C^2} + \frac{i}{2} = 0 \qquad (12)$$

Then solving for C yields

$$C = \sqrt{\frac{2bT}{i}} \tag{13}$$

which implies that demand for average nominal balances, and hence the average transactions demand for money is

$$(M^d) = \frac{C}{2} = \frac{1}{2}\sqrt{\frac{2bT}{i}} \tag{14}$$

or

$$\ln (M^d) = \ln (\frac{1}{2}\sqrt{2}) + \frac{1}{2}\ln b + \frac{1}{2}\ln T - \frac{1}{2}\ln i \tag{14'}$$

But here it must be noted that nothing explicit was said about the utility of holding money for transactions purposes. The elasticity of demand for nominal balances with respect to total transactions is one-half, which implies economies of scale in money holding. The interest elasticity is a negative one-half and the brokerage cost elasticity is a positive one-half. In most macroeconomic textbooks, the above equation is called the "square root rule". There are two important implications from the fact that Baumols' model predicts that demand for money will increase less than proportional to the volume of transactions: (1) the demand for money depends on the distribution of income, if the distribution of income varies, so will the demand for money; (2) having the economics of scale in money holdings, the monetary policy may be more powerful in influencing economic activities. If equation (14) is put in the following form:

$$\ln T = 2 \ln (M^d) - 2 \ln (\frac{1}{2} \sqrt{2}) - \ln b + \ln i \qquad (15)$$

Then at a given rate of interest and broker's fee, doubling the quantity of money requires that the level of income must be doubled in order to absorb such increase in money.

In their recent article, Buiter and Armstrong (14, p. 529) argued that:

> . . . there is unsatisfactory dichotomy in much of the literature on the demand for money between the portfolio theoretic approach, which emphasizes risky asset returns but ignores transactions costs (Tobin, 1956) and the inventory theoretic approach, which emphasizes transactions costs, but ignores risky asset returns (Baumol, 1952).

They also indicated that this dichotomy is not only unsatisfactory, but also unnecessary, so that it is preferable to integrate these two approaches. However they concluded that the income elasticity will be greater than unity, when considerations of risk are introduced to the Baumol model. The income elasticity is always one-half, only when the economic unit's objective is equivalent to the maximization of the expected return.

The Supply of Money

Less attention was given to determinants of the money supply, because most economists before the fifties considered the money supply as an exogenous variable under the control of the Central Bank. In addition, the money supply is believed by some economists that it has no relevant role in affecting prices and income, and it is as a residual entity, and hence it has no important influence in the economic activities[4]. However, late in the fifties and early in the sixties, some attempts were made in deriving distinct money supply theories which may give an appropriate explanation to the main determinants of money supply. According to Brunner and Metzler (13, p. 243), there are three recent theories of money supply which may be classified as free reserves, surplus reserves, and adjustment ratios theories. That is, the first theory centers on the banks' adjustment to free reserves. Free reserves are the difference between excess reserves (R^e) and the borrowing from the Central Bank (B), that is:

$$R^f = R^e - B$$

The surplus reserves theory for explaining the money supply centers on the bank's response to surplus reserves, the latter is equal to actual less desired reserves which is the difference between total actual reserves and the required reserves imposed by the Central Bank.

The third theory centers on some adjustment actual desired allocation ratios. This theory explains the money supply through its investigation of the demand behavior for two main ratios: currency-deposit ratio and reserve-deposit ratio, which are consequently influenced by the private non-banking sector and by the banking sector. In addition, the monetary base is also considered an important factor influencing money supply and it is under the control of the monetary authority; that is the reason why the monetary base is taken as

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[4]There is also a statistical difficulty in nature. That is, according to D. Fand (35, p. 380) it is not possible to estimate a supply function if the parameters are affecting both demand and supply. But he indicated that this problem is solved by the assumption that the demand for money is a demand function for real balances while the money supply function is the supply of nominal money balances.

exogenous in most cases.

But concerning the adjustment ratio theory to the money supply, it is preferable to explore the main two identities of determinants of the money supply developed by Friedman and Schwartz (41) and Cagan (16). In this study the Friedman-Cagan model is used.

Both Cagan (16) and Friedman and Schwartz (41) start with the following money supply identity:

$$M = mH \tag{16}$$

That is they have the same concept for the multiplier (m). They are also alike in showing three sectors affecting the money supply, the Central Bank, the commercial banks, and the public. But they differ in how those desired ratios representing the commercial banks and the public sectors. Define:

$$M = C + D \tag{17}$$

$$H = R + C \tag{18}$$

Where M is money supply, C is currency outside banks, D is deposits (demand and time) of the public at banks, H is the monetary base or high powered money and R is reserves of commercial banks.

Cagan started by dividing equation (18) by (M) to get:

$$\frac{H}{M} = \frac{R}{M} + \frac{C}{M} \tag{19}$$

Then multiply (17) by R and divide by DM:

$$\frac{RM}{DM} = \frac{RC + RD}{DM} = \frac{R(M - D) + R(M - C)}{DM}$$

$$\frac{R}{D} = \frac{RM}{DM} - \frac{RD}{DM} + \frac{RM}{DM} - \frac{RC}{DM}$$

$$= \frac{R}{D} - \frac{R}{M} + \frac{R}{D} - \frac{R}{D} \cdot \frac{C}{M}$$

$$\therefore \left(\frac{R}{M}\right) = \frac{R}{D} - \frac{R}{D} \cdot \frac{C}{M} \tag{20}$$

Then we substitute (20) in (19) to get:

$$\frac{H}{M} = \frac{C}{M} + \frac{R}{D} - \frac{R}{D} \cdot \frac{C}{M} \tag{21}$$

Therefore the money supply identity of Cagan (7) is:

$$M = \frac{H}{\left(\frac{C}{M}\right) + \left(\frac{R}{D}\right) - \left(\frac{R}{D} \cdot \frac{C}{M}\right)} \tag{22}$$

Thus H, and other two ratios are determined by the mentioned three sectors. The monetary authority may control the stock of high powered money, the commercial banks cannot control both the reserves and deposits but they can control the reserve-deposit ratio, while the public can control the currency-money ratio. The partial derivatives of M with respect to H, $\frac{C}{M}$, $\frac{R}{D}$ are:

$$\frac{\partial M}{\partial H} > 0, \quad \frac{\partial M}{\partial (\frac{C}{M})} < 0, \quad \frac{\partial M}{\partial (\frac{R}{D})} < 0$$

That is to say, the money stock is positively related to the stock of high powered money and negatively related to both currency-money ratio and the reserve-deposit ratio.

While the money supply identity of Friedman and Schwartz (41) can be derived also from equations (17) and (18), as follows:

$$\frac{M}{H} = \frac{(C + D)}{(R + C)} \tag{23}$$

Then dividing all terms on the right side by C and multiplying by $(\frac{D}{R})$ we get the original identity found in the text (13):

$$M = \frac{(\frac{D}{R})\ (1 + \frac{D}{C})}{(\frac{D}{R}) + (\frac{D}{C})} \cdot H \tag{24}$$

It is obviously from identity (24) that the money supply is directly related to its three determinants H, $(\frac{D}{C})$ and $(\frac{D}{R})$. But these ratios are slightly different to those of Cagan. Friedman and Schwartz use the deposit reserve ratio instead of the reserve-deposit ratio and the deposit-currency ratio instead of the currency-money ratio. One can divide all terms on the right side of equation (23) by D to get:

$$M = \frac{1 + \frac{C}{D}}{\frac{C}{D} + \frac{R}{D}} \cdot H \tag{25}$$

So in this formulation the only difference between Cagan and Friedman and Schwartz is that the ratio representing the public behavior is given in terms of currency to deposits (the component of money supply) rather than in terms of currency to total money supply.

The money supply in identity (25) is directly related to the stock of high powered money and inversely related to both the currency-deposit ratio and the reserve-deposit ratio. These two ratios are mostly considered as endogenous variables. The factors affecting these ratios are discussed in detail in Chapter IV so it is preferable to close our discussion in this respect in order to avoid repetition.

Supply of Money and the Rate of Interest

According to the Keynesian analysis, the rate of interest is determined by the supply of and demand for money, so that an increase in the money supply tends to reduce the level of the interest rate. The money supply is shown as a function of the interest rate (i), the discount rate of the Central Bank (ρ), reserve requirement (r^r), and the actual adjusted monetary base (H^a):

$$M^s = m(i, \rho, r^r) \cdot H^a$$

Where the partial derivatives are: $m_1 > 0$, m_2, $m_3 < 0$. But most empirical studies of the money supply do not show much support to the interest rate sensitivity of the money supply. R. Rasche surveys (91) empirical evidence on such sensitivity and he concludes that the interest elasticity with respect to money supply is found to be extremely low[6]. However Friedman (39) argued that most economists misunderstand the relationship between the money supply and the interest rate. The interest rate is the price of credit, as an increase in credit tends to reduce the rate of interest. Thus he indicated that it is the confusion of credit with money that leads to the belief that an increase in money supply reduces the level of the interest rate. To him, the interest rate is not the price of money. Friedman indicated also that the price of money is the inverse of the price level, so that when money supply increases the prices of goods and services tend to increase also, i.e., the purchasing power of money falls.

Money and the Balance of Payments

The relationship between money and the balance of payments has been recognized in the old economics literature, especially in the writings of Hume (52) and Ricardo (92). Hume supposed if all the money of Great Britain were multiplied five-fold in a night, a rise in prices would occur, and hence no neighboring nations could afford to buy from Britain; but Britain would buy from them, so money would flow out, and hence Britain would suffer an external imbalance (p. 27). The same notion of external imbalances arising from money market disequilibria was also advanced by Ricardo, as he indicated that exporting money in exchange for goods which is termed an unfavorable balance of trade, never arises but from a redundant currency

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[6] Fand (35) has compared money supply elasticities calculated from different econometric models, indicating that interest rate elasticities exhibit greater variability, and some instability, while other independent variables elasticities are found to be consistent.

(p. 59). However Frenkel and Johnson (37) showed some evidence that the monetary approach to the balance of payments was well known and may become the dominant theory of the balance of payments. Other developments of this theory can be found also in the writing of Mundell (81, 82), and in other recent studies which contain general discussions of this approach, such as that of Grubel (48), Whitman (107), Swoboda (98) and Mussa (83).

In general, the proponents of this approach have emphasized three assumptions for building such a theory: (a) the world is well integrated, so that the money prices of goods and securities in terms of any currency tend to be equal when there is free trade between countries; (b) money does not affect employment or output, as a monetary model is said to be concerned with the long run[7], thus the assumption of full employment is an appropriate one; (c) that a discrepancy between the quantity of money supplied and the quantity demanded has a direct effect on the balance of payments. Mundell (81, p. 121) emphasizes the relevance of this assumption by indicating that a reduction in the money supply has an immediate effect on the balance of payments, and it is more important in the adjustment mechanism, than that ultimate effects on income.

In general, the above three assumptions imply the monetarist models where the stock equilibrium is obtained, compared to the flow equilibrium obtained in the conventional Keynesian models. That is

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[7]It is easy to build a monetary model for an open economy where real income varies in the short run, maintaining the neutrality of money in the long run on one hand, and the automatic monetary mechanism of payments adjustments on the other.

there is a great deal of change in the theoretical approach to balance of payments problems, as indicated by Johnson (57, p. 15) that "the change has been from the idea of mechanism of adjustment to the idea of the balance of payments as a policy problem." Then the existence of such a problem assumes there is a monetary authority, since all transactions recorded in the balance of payments (B.O.P.) are just a reflection of monetary phenomena. That is, the desired money demanded and the money supply process are the instruments to be investigated when a problem arose in the B.O.P. The monetary authority may intervene in the foreign exchange market to peg the rate of exchange or using official reserves of gold and foreign exchanges to cure the B.O.P. problem. The main target of the monetary authority is to maintain the equilibrium between the country's demand for foreign exchange to pay for imports and the supply of foreign exchange in return for domestic currency to pay for exports, if the annual equilibrium in the B.O.P. is desired.

In the case of fixed exchange rate system, Mundell (81, p. 153) indicated that money income (or price level) moves to equilibrate the demand for and supply of domestic goods and services, while the monetary policy is directed toward the foreign balance. But in the flexible exchange system, the exchange rate is able to correct the external disequilibrium, and hence the monetary policy must take care of the internal stabilization. The price level tends to rise or fall depending on whether there is a surplus or deficit in the B.O.P. Thus Mundell argued that if the Central Bank stabilizes the exchange rate, it must be prepared to buy and sell foreign exchange reserves at a fixed price, while if it stabilizes the price level, then it must buy and sell goods and services at a fixed price.

Now let us assume an increase in the real money balances above the real quantity demanded, so this increase implies an excess demand for goods, services and securities. This excess demand cannot be eliminated only through changes in the domestic price level under a fixed exchange rate when the country is involved in trade with other countries, but the adjustment mechanism operates through changes in relative prices, that is the domestic price level rises with respect to the foreign price level, and hence it must be solved through a B.O.P. deficit by more imports and less exports. Thus when demand for foreign exchange increases, the Central Bank must sell foreign exchange in order to avoid the depreciation of the domestic currency. The sales of foreign exchange reduce the stock of money supply, and hence eliminating the money market disequilibrium.

Most empirical studies on the monetary approach explaining the B.O.P. behavior have employed the reduced form model proposed by Johnson (54); thus, it is preferable to explore his model as an example for this theoretical framework. One of the assumptions is that the supply of money is instantaneously adjusted to the demand for money; therefore the model refers to the long run equilibrium; full employment is also assumed. Other important assumptions are: the exchange rate is fixed, the country is small and open, so that its price level has to keep in line with the world price level, growth in real output is not affected by monetary disequilibria. Now consider the consolidated monetary survey of the whole banking system, where the money supply is equal to net foreign assets plus net domestic assets of the banking sector, therefore

$$M^s = NFA + NDA \tag{26}$$

Where M^s is money supply, NFA is net foreign assets and NDA is net domestic assets. Then Johnson (54, p. 156) put his demand function for money as follows:

$$M^d = Pf\ (RY,\ i) \tag{27}$$

Where M^d is demand for nominal money balances, P is the foreign and therefore the domestic price level, RY is real output and i is the nominal rate of interest. And the equilibrium condition for the money market is:

$$M^d = M^s \tag{28}$$

Now for simplicity, replace NFA by (R) as international reserves and NDA by (D) which represents domestic credit or domestic assets backing of the money supply. Thus the reduced form of the above three equations is:

$$R = M^d - D = Pf\ (RY,\ i) - D \tag{29}$$

But the current overall balance of payments B(t) is equal to the change in reserves (R), that is

$$B(t) = \frac{dR}{dt}$$

So, the reduced form can be put in terms of growth rate, and letting $r = R/M^s = R/M^d$ the initial international reserve ratio, it becomes[7]:

$$GR = \frac{1}{r} (GP + \alpha_Y G_Y - \alpha_i G_i) - \frac{1 - r}{r} GD \qquad (30)$$

Where GR is the growth rate of reserves $(\frac{1}{R} \cdot \frac{dR}{dt})$, GP is the growth rate of the price level, Gy is the growth rate of real output, Gi is the growth rate of the interest rate, and GD is the growth rate of net domestic credit.

That is to say reserve growth is positively related to the domestic economic growth and the price level growth, while it is negatively related to the rate of interest growth and the rate of domestic credit expansion. But these results are contrasted with one of the Keynesian theories concerning the relation between the B.O.P. and economic growth, as it is derived from the multiplier analysis, that is economic growth tends to increase imports relative to exports, and hence reduce the level of reserves. However this negative relationship arises because this theory neglects the effects of demand for money on import demand and export supply.

But the assumption of equality between domestic and foreign price levels cannot be maintained if the proportion of tradeable to non-

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[7] Equation (30) is obtained by the following steps:

from (27) $\quad GM^d = GP + \alpha_Y G_Y - \alpha_i G_i \qquad (31)$

from (29) $\quad GR = \frac{M^d}{R} GM^d - \frac{D}{R} GD \qquad (32)$

since $\quad \frac{D}{R} = \frac{M^s - R}{R} = \frac{1 - R/M^s}{R/M^s} = \frac{1 - r}{r}$

and substitute (31) in (32) equation (30) is obtained, and where α_Y and α_i are income elasticity and interest elasticity of the demand for money, respectively.

tradeable goods is a considerable one. That is the domestic inflation rates, at least for some time, differ from that of the world inflation because part of the excess supply of money is absorbed by a rise in the prices of domestic goods (non-tradeable).

Swoboda (98, p. 254) indicated that by increasing money supply the movement to the equilibrium point will tend to be slower with non-tradeable goods present in the system, that is a low proportion of traded to non-traded goods and also a low degree of capital mobility will make the period of adjustment longer, or the speed of adjustment will be reduced. This is mostly the case in the most of the less developed countries. However in the long run both internal and external inflation rates converge and the excess money supply is wholly eliminated through the balance of payments.

Now it is preferable not to review the other approaches analyzing the B.O.P., since this study concerns only the linkage between money market and the B.O.P. But the reader may find these approaches namely: the elasticities approach, the absorption approach, and the macro-economic-price approach, in the works of Robinson (93), Alexander (1) and Mead (78), respectively.

But during the last decade, it is found that the absorption approach to the B.O.P. to be of a limited use. Dornbush (31, p. 880) concluded that "a devaluation is for most a monetary phenomenon and that its effects derive from the reduction in the real value of money attendant upon a devaluation." Johnson (56, p. 9) argued that as the absorption approach concentrates on expenditures flows, it does not recognize that a continuing deficit may correct itself without devaluation, by reducing the stock of real balances, that is if real balances are not continually renewed by increases in domestic credits in order to offset the effects of reserve losses. Therefore deflating real balances will not lead a devaluation to improve the B.O.P.

CHAPTER III

THE STRUCTURE OF THE LIBYAN ECONOMY

Introduction

In the 1950's, the Libyan economy was faced with the main facts of economic backwardness: most of the people lived on a subsistence level, there was little hope for finding any kind of resources, agricultural production depended on climatic conditions, per capita income was less than fifty dollars per year and capital formation was zero if not negative. Thus Higgins (15) (who wrote a report on economic development in Libya in 1952 submitted to the United Nations) indicated in his book, Economic Development Principles, Problems and Policies, First edition, that Libya seemed to be an almost hopeless case. He insisted also that Libya had a capital-deficit economy everywhere. In addition, there was not enough human skill or Libyan entrepreneurship, so that the important occupation of Libyans (other than agriculture) was textiles and handicrafts, while other activities such as commerce and foreign trade were in the hands of the Italians remaining from the Italian invasion of Libya during the period between the two World Wars.

But following the discovery of oil and the start of oil exports late in 1961, the economy grew rapidly. The oil sector started to have a dominant role in the economy. Foreign assistance was replaced by oil revenues which has also become the sole financing source in the government economic development plan. It was stated in the law that 70% of the oil revenues should be allocated to development, but this percentage level has never been met, neither during the kingdom's regime, nor during the revolutionary regime, because there are limits to the absorption of capital. Because of the oil sector's role, the economy becomes a dualistic structure, and the half-skilled labor drift to oil sector from other sectors. The oil sector's impact on the economy was mostly through the government's expenditure of its oil revenue, and to a very small degree, through the oil companies' domestic spending. The government concentrated development spending in the non-oil sector so that the economy may decrease its dependency on oil. Therefore the independence from oil sector became a very important target in the economic development plans in the seventies. By establishing some chemical industries, the development plans tend to integrate the oil sector into the other sectors of the economy. The government has also devoted much attention to the human developments in order to increase the supply of skilled labor, but because of the annual growing allocations for economic development, these allocations can only be absorbed by importing more skills, so that the Libyan economy will be more dependent on imports of foreign skills. Thus it seems that the government's two targets — independence from foreign skills and independence from oil sector —contradict each other. However, these two targets may be achieved in the long run, with the hope that the oil reserves last beyond this long run.

Now the question may arise, what is the best approach to the economic growth in Libya? Nurkse (85) developed his 'balanced growth' theory on the assumption of an unlimited supply of capital and lack of strong exports. This model was not realistic in the past, as all underdeveloped countries had a lack of capital, but now, the oil producing countries which have a substantial supply of foreign exchange, effectively meet Nurkse's requirements. The other alternative approach is the unbalanced growth framework recommended by Hirschman (51). This model cannot assure that the expansion in one sector may generate growth in others. However all economic development plans conducted whether before the First September revolution[1] or after did not follow either theory mentioned above. But it might be said that those development plans of the sixties are closer to the 'unbalanced growth theory', so that some sectors, such as manufacturing industry, were left without development, while those development plans of the seventies carry some characteristics of the 'balanced growth theory' so that self-sufficiency especially in foodstuffs becomes the main target of the country.

In 1978, Libya was exceptional among developing countries in having a capital-surplus rather than a capital deficit economy. That is, it possessed more capital than its home economic capacity of absorption. But the government budget is still characterized with deficit, except in 1966 when the first budget surplus in Libya's history occurred, resulting from a huge increase in oil revenues in the same year (84, p. 134). The World Bank was no longer including Libya in the list of developing countries in 1978. That is, Libya was defined as a capital-surplus oil exporting nation, and it was categorized with other

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[1]The First September Revolution started on 9/1/1969.

capital-surplus oil exporting countries, such as Kuwait, Saudi Arabia and other Gulf countries. The fiscal year had begun in April until 1974 when it has been concurrent with the calendar year.

This chapter gives a brief review of the main developments in the sectors which are covered by our econometric monetary model. That is, the discussion will be on the monetary sector, the oil sector, the non-oil sector and the balance of payments. Here it should be noted that because government fiscal policies are affecting each sector, discussion on these policies are given when it is appropriate, expecially in the non-oil sector.

The Monetary Sector

When Libya gained its independence on December 24, 1951, the Libyan people found themselves with a lack of skills, education, and experience in the field of banking. That is, banking activity was largely out of Libyan hands, except for a few customers who were small borrowers or depositors. On the eve of independence there were only two banks offering primary banking services (5, p. 78). One of them was the Barclays Bank which had taken the responsibility of issuing the Libyan currency in the absence of a Libyan Central Bank. That is, because Libya became a member of the sterling bloc when independence was established in 1951, and the new issued currency unit remained tied to sterling until the sterling devaluation of November 1967. However, Libya continued as a member of the sterling bloc until December 1971 when the revolutionary government withdrew from the said membership, following its nationalization of the British Petroleum's assets. Then later as a result of increasing economic activity such as the starting of oil exploration and the growing public expenditures on social and economic development, the number of commercial banks increased to eight, all of which were branches of foreign banks. The Central Bank of Libya, including a commercial banking division in it, was established in April 1956; this was the first instance of a Libyan institution undertaking banking transactions.

By the Banking Law of 1963, the Central Bank of Libya became to a large degree a traditional central bank. This law called also for Libyan participation in the ownership of the existing banks of at least 51% of their capital. Late in 1963, the Central Bank called the operating branches of foreign banks exercising moral persuasion, to lead them to be transformed into Libyan firms of which 51% of their capital being owned by Libyans (6, p. 132). But only four small banks had accepted this new nationalistic policy of Libyanization, while the others including the largest two banks, Barclays and Banco di Roma, ignored such a policy until November 1969 when a revolutionary ministerial decision prescribed that 51% of the capital of each of the four branches of foreign banks was to be taken over by the government. In fact this is partly nationalization, despite the announced decision indicative that this share is to be sold to Libyans (6, p. 137). When this decision was issued, there were ten banks in Libya, one of which was wholly owned by Libyans. These banks had 53 branches at the end of 1969 compared to 43 branches at the end of 1968 (3, p. 42). But after one year only the rest of foreign ownership in the banking sector was nationalized on the 22nd of December 1970 by the law nationalizing foreign shares in banks, reorganizing them and determining the limit of the share, Libyans may hold. The law put a ceiling amounting to L.D. 5 thousand (5,000 Libyan

Dinars) on the nominal value of what a person and his relatives up to the fourth degree may own in the capital of any bank. The only justification given for this action as stated in the Central Bank's Economic Bulletin (4, p. 50), is "in order to put an end to the capitalist monopolies in the banking sector." The law also reorganized the commercial banks, in such a way, that separates the Commercial Banking Division from the Bank of Libya and merged with other two small banks, in a joint stock company under the name of El Masrab El Tijari El Watani, which is wholly owned by the Bank of Libya. The other five small banks, most of them having a proportional private ownership were merged into a joint stock company under the name of Masrab El Wahda. Thus the number of commercial banks operating in Libya since December 1970 is only five banks as the door for new entry is closed. However banking expansion is permitted through more branching especially in the rural areas, but prior approval must be obtained from the Central Bank before a new branch can be opened.

There are also three specialized banks: Agricultural Bank, Real Estate and Industrial Bank, and the Libyan Arab Foreign Bank. The first banks may be considered as government agencies distributing zero interest loans to citizens who meet the conditions stated in the bank's constitution and decisions, while the third bank was recently established with a paid up capital of L.D. 20 million for investments abroad and it is wholly owned by the Central Bank of Libya. The Bank's activity is mostly concentrated in its participation in several companies and banks abroad as well as financing establishment projects in some friendly countries. In 1971 the Banking Law No. 4 of 1963 was amended by the Law No. 63 of 1971 (25, p. 1-7) introducing some necessary changes required for the new developments in the banking sector. One of the amendments is a change in the unit of account to the Dinar and Dirham from the old denominations of the Libyan currency (Pound and Millieme), maintaining the same gold parity (2.48828 gram). The currency is still sometimes referred to as the pound, and retail traders sometimes quote prices in piastres (the Libyan pound divided into 100 piastres). The said amendment maintains also the Central Bank's supervision and control over commercial banks and provides a new duty of establishing commercial banks or participating in the establishment of such banks, despite the fact that this new duty is not expected to be used in the visible future.

Monetary Policy

Regarding the tools of monetary policy, all tools except open market operations, are available and can be used for regulating the money supply. But these tools, such as the bank rate and reserve requirements, were not used much during the whole period. The bank rate remained constant at 5 per cent from February 1961 to the current time and the first actual rediscounting transactions began only in 1962, while the reserve requirement ratio was changed only once in July 1966 from 10 per cent to 15 per cent on demand deposits and from 5 per cent to 7.5 per cent on time and savings deposits. This increase in reserve requirements in addition to other measures has been taken as a result of the observed creeping inflation which was increased by 4.5 per cent as average per year during the prior three years and by about 13.7 per cent during 1966 alone. These two tools became less effective as a result of the ceiling put on rates of interest by the Central Bank. That is, the rate of interest is fixed at maximum as 7 and 7.5 per cent per annum for secured and unsecured borrowings, respectively. No interest was paid on demand deposits, but no more than 4 per cent can be paid on other kinds of deposits. All these rates are linked to the bank rate of 5 per cent, therefore if a rise in the interest rate is wanted, the bank rate must be increased by this rise. So a constant bank rate during the whole period reflects the Central Bank's policy of maintaining a constant rate of nominal interest in the money market.

The Bank of Libya required also a liquidity ratio which was inherited from the Banking Law of 1958. This ratio of liquid assets to deposit liabilities including cash guarantees kept against letters of credit started by 20 per cent in 1958, then it was changed twice: up to 25 per cent on the first of July 1966 and back to 15 per cent on the first of November 1970. The latter change arose because of the year 1970 witnessing a sizeable economic recession and the decrease in liquidity ratio may lead to a higher level of excess liquidity and the latter leads banks to grant more credits for stimulating economic and business booms. The definition of liquid assets has also been changed twice: (a) from April 1965 liquid assets consisted of vault cash (in domestic and foreign) and deposits at the Central Bank; (b) from the first of May 1970 liquid assets consisted of vault cash (in domestic and foreign), deposits at the Central Bank and deposits at the commercial banks in Libya, while prior to April 1965, liquid assets consisted of vault cash (in domestic and foreign) and demand deposits held with the Central Bank and commercial banks operating in Libya or abroad.

Thus it seems that the Central Bank of Libya does not rely so much on the bank rate and the reserve requirements. But it may be said that monetary policy has been working through moral suasion and selected credit controls during the first period (1962 - August 1969)(5, p. 32-34), while during the later period (September 1969 - 1977) especially after the promulgation of Law No. 63 of 1971 amending certain provisions of the BAnking Law No. 4 of 1963, the monetary policy has been working through a direct decision since the Central Bank owns wholly the largest three banks and partly (51% or more) of the other two banks. It may work also through a committee established under the name, The Committee of Commercial Banks, which consists of general managers of commercial banks, directors of all main divisions of the Central Bank of Libya, and the governor and his deputy. Thus cooperation and moral suasion became easier to be practiced, despite even those members representing commercial banks still being considered employees of the Central Bank. However, it is still true that monetary policy works through selected credit controls and moral suasion during the later period, but with a stronger emphasis and more effective compared to those practices during the first period.

Monetary Indicators

Now concerning actual trends of monetary indicators, it was preferable to discuss money supply trends and factors affecting them. Table I shows the growth rates of the monetary indicators. Money supply, narrowly defined, was increasing very rapidly especially during the first period with an average annual growth rate of 29.8 per cent compared to a little slower rate of 29.2 per cent during the later period. The currency component grew by an annual average of 27.1 per cent while the demand deposit component showed a growth amounting to 32.3 per cent, compared to about 30 per cent in each

TABLE I

PERCENTAGE CHANGES IN MONETARY VARIABLES (ORIGINAL DATA, END OF YEAR)

	CC	DD	TS [1]	M1	M2	H	NF	D	m1	m2
1962	18.0	4.8	34.3	11.2	16.2	16.9	3.0	-15.4		
1963	17.9	16.8	18.6	17.4	17.7	20.3	28.3	43.0	-2.37	-2.12
1964	38.2	27.1	35.4	32.9	33.6	33.0	40.9	53.2	-0.02	0.44
1965	36.6	63.7	37.8	48.9	46.1	62.5	44.0	19.2	-8.40	-10.13
1966	42.0	30.5	-18.0	36.3	23.2	35.5	36.1	37.0	0.56	-9.07
1967	27.9	29.3	22.3	28.5	27.5	37.0	11.0	-33.3	-6.18	-6.90
1968	15.4	42.9	7.4	28.6	25.3	21.8	39.8	106.2	5.54	2.86
1969	45.5	24.6	3.3	34.4	30.3	34.6	71.8	153.0	-0.16	-3.20
1970	9.6	29.5	23.6	19.4	19.9	13.5	75.7	148.1	5.17	5.55
1971	7.5	89.2	15.3	51.2	47.3	57.7	53.9	51.9	-4.13	-6.58
1972	22.1	8.9	53.3	13.3	16.7	16.9	10.0	6.1	-3.08	-0.21
1973	37.4	17.3	43.1	24.5	26.5	9.3	-32.6	-58.1	13.87	15.75
1974	29.4	57.9	107.7	46.7	54.3	46.8	95.7	173.5	-0.10	5.10
1975	32.0	6.1	-2.3	15.1	12.2	14.1	-39.7	-85.7	0.85	-1.71
1976	26.0	34.9	0.7	31.3	26.8	23.2	43.9	185.1	6.60	2.95
1977	34.2	22.1	34.9	26.7	27.7	26.7	49.2	115.1	-0.02	0.73
Average (62-69)	30.2	30.0	17.6	29.8	27.5	32.7	34.5	45.4	-1.38	-3.52
Average (69-77	27.1	32.3	31.1	29.2	29.1	27.0	36.4	76.5	2.11	2.04

(1) From monthly average data. CC = durrency outside banks; DD = demand deposits; TS = time and savings deposits; M1 = money narrowly defined; M2 = money broadly defined; H = the monetary base; NFA = net foreign assets; D = credit creation in the country; ml = multiplier of M1; m2 = multiplier of M2.

component during the first period, so the decrease in currency component was offset less than wholly by that increase in demand deposits. Regarding time and savings deposits, they oscillate from month to month, so they are made a little bit smooth by taking the monthly average for each year rather than that at the end of the year. These deposits show a very rapid rate of growth during the later period, as most parts of it belongs to the government institutions, amounting to 31.1 per cent compared to 17.6 per cent during the first period. Therefore because of the lower growth rate in time and saving deposits relative to that of demand deposits, money broadly defined (M2) shows a lower rate of growth relative to that of (M1) during the first period and being about equal during the later period.

A glance at data of money supply and the monetary base shows a strong relationship between them. That is, when the monetary base is increased, money supply is also increased, except in 1968 and 1973, which may arise from the consequences of the 1967 war and the 1973 war between some Arab states and Israel.

The monetary base is mostly affected by the net foreign assets (NFA) and the net domestic assets or credit creation by the Central Bank. The data of credit creation (D) in Libya is negative because the Central Bank absorbed more deposits than creating credits, and hence the positive changes in (D) is augmenting net foreign assets, as the Central Bank is the only holder of foreign financial assets for investment. Therefore when (D) shows a negative change such as in 1967, 1973 and 1975, net foreign assets shows a lower rate of growth in 1967 and a negative rate of growth in 1973 and 1975, because these negative changes mean that more credit creation occurred, or in other words, more deposits has been withdrawn from the Central Bank and spent on imports and other domestic goods, and hence the flow of foreign reserves slows down. This coincides with the theoretical view that credit creation is negatively related to the flow of foreign reserves. However, it can be said that the average rate of deposit absorption by the Central Bank is 45.4 per cent during the first period compared to a higher rate of 76.5 per cent during the later period. Net foreign assets are also increased, but by a lower average rate of growth amounting to 34.5 per cent and 36.4 per cent during the first and the later periods, respectively.

The multiplier is just the ratio of money to the monetary base and it is a function of currency-deposit ratio and reserve-deposit ratio. The non-banking sector can influence the currency-deposit ratio and adjusts it to the desired ratio, while the commercial banking sector appears to control the reserve-deposit ratio and adjusts it to its desired one. But the Central Bank can influence the reserve-deposit ratio indirectly through altering its legal reserve requirements. However, it can be said that the Central Bank's influence on the money multiplier is not potent.

The money multiplier (m1) shows a negative average rate of growth during the first period, compared to a positive rate of growth during the later period. The multiplier of money broadly defined (m2) goes in the same direction as that of (m1). Table II shows the main variables affecting the money multiplier. The ratio of currency to demand deposits decreased from an annual average of 1.07 during the first period to 0.68 during the later period. The decrease in the currency-demand deposit ratio did not arise from a decrease in demand

TABLE II

MONEY MULTIPLIER AND FACTORS AFFECTING IT (END OF YEARS)

	m1	m2	$\frac{CC}{DD}$	$\frac{CC}{TD}$	rd2 %	GR %	$\frac{R}{DD}$	$\frac{R}{TD}$	ALr %	GRY %	$\frac{DD}{TD}$	$\frac{WS}{YP}$
1962	1.293	1.723	1.11	0.65	2.95	14.0	0.42	0.25	6.90	27.46	0.59	0.417
1963	1.262	1.686	1.12	0.65	2.96	12.3	0.40	0.24	7.90	37.10	0.58	0.467
1964	1.262	1.694	1.22	0.69	3.30	-18.8	0.26	0.15	8.59	26.61	0.57	0.487
1965	1.156	1.522	1.02	0.62	2.73	161.1	0.43	0.26	8.52	33.81	0.61	0.503
1966	1.162	1.384	1.10	0.79	2.59	15.6	0.38	0.27	12.71	13.04	0.71	0.494
1967	1.091	1.288	1.11	0.80	2.30	40.5	0.41	0.30	12.72	8.65	0.72	0.489
1968	1.151	1.325	0.88	0.69	2.51	10.5	0.32	0.25	13.02	36.27	0.78	0.541
1969	1.149	1.283	1.03	0.83	2.78	-14.2	0.22	0.18	12.92	8.04	0.81	0.375
1970	1.209	1.354	0.87	0.71	2.68	60.8	0.27	0.22	12.81	-0.13	0.82	0.565
1971	1.159	1.265	0.50	0.44	1.91	161.9	0.37	0.33	13.58	31.08	0.88	0.625
1972	1.123	1.262	0.55	0.47	1.89	18.3	0.41	0.34	13.14	7.36	0.84	0.500
1973	1.279	1.461	0.65	0.53	2.95	-38.6	0.21	0.17	13.22	18.14	0.81	0.592
1974	1.277	1.536	0.53	0.41	2.73	121.9	0.30	0.23	13.08	62.31	0.76	0.606
1975	1.288	1.510	0.66	0.52	2.83	-3.9	0.27	0.21	13.51	-9.08	0.78	0.612
1976	1.373	1.554	0.62	0.51	2.86	29.4	0.26	0.21	13.51	24.77	0.82	0.605
1977	1.373	1.565	0.68	0.55	2.99	9.6	0.23	0.19	13.58	13.15	0.81	0.685
Average (62-69)	1.191	1.488	1.07	0.72	2.77	28.9	0.36	0.24	10.41	23.87	0.57	0.472
Average (69-77)	1.248	1.418	0.68	0.55	2.62	38.4	0.29	0.23	13.26	17.29	0.81	0.574

Note: m1 and m2 are as defined previously; $\frac{CC}{DD}$ = currency-demand deposit ratio; $(\frac{CC}{TD})$ = currency-total deposit ratio; rd2 = the competative rate of interest paid on total deposits; GR = growth of reserves; $\frac{R}{DD}$ = reserve-demand deposit ratio; $(\frac{R}{TD})$ = reserve-total deposit ratio; ALr = average reserve requirement; GRY = growth of real GNP; $(\frac{DD}{TD})$ = demand deposit-total deposit ratio; $(\frac{WS}{YP})$ = ratio of wages and salaries to non-oil GDP.

for currency relative to demand for demand deposits by the private sector, but it arose from an increase in the number and size of government economic enterprises which are supposed to hold only deposits.

The reserve-demand deposit ratio constitutes an annual average of 0.36 during the first period which means that excess reserves were more than two times the average legal reserve requirements, while during the later period the average level of reserve requirement increased to 13.26 per cent and the $(\frac{R}{DD})$ decreased to 0.29 showing a lower level of excess reserves. This decrease in $(\frac{R}{DD})$ ratio partly arose from the increase in demand deposit-total deposit ratio from an annual average of 0.57 during the first period to 0.81 during the second period, so there is an inverse relationship between these two ratios, because legal reserve requirements on demand deposits (15 per cent) exceeds that required on time and saving depsoits (7.5 per cent). Prior to July 1966, legal reserves were 10 per cent on demand deposits and 5 per cent on time and savings deposits, so that this tool of monetary policy was altered only once in July 1966 as a measure for curbing inflation felt in that period which proved to be not potent as long as fiscal policy did not cooperate in reducing its expenditures.

The Oil Sector

Some major oil companies started oil exploration in Libya in 1955, but the first oil production by Esso was exported in November 1961. The Libyan authority had given special considerations to independent oil companies in order that the country would not be in the hands of a single oil company as in the case of Iraq, Saudi Arabia and Kuwait.

In 1970 there were thirty foreign companies engaged in production activities. The independents such as Occidental discovered rich oil fields very rapidly and started exporting crude oil until exports reached a peak of 243 billion barrels in 1970 compared to 247 billion barrels exported by the Esso group and 344 billion barrels exported by Oasis group. However total oil output rose rapidly in the sixties to reach a peak of 3.31 million barrels per day (mbd) in 1970 compared to 1.21 mbd in 1965, 1.43 mbd in 1975 and 2.1 mbd in 1977.

In fact the oil sector dominates economic activity; it contributes an annual average of 48.8 per cent of gross domestic product during the first period compared to 43.1 per cent of gross domestic product during the later period. Decreasing dependency on the single oil product is a major goal of the revolutionary government during the later period, so more attention was given to development of the non-oil sector resulting with a higher contribution in total gross domestic product, or a lower contribution by the oil sector as mentioned above.

With regard to the oil prices, the posted prices for 40° API crude oil in U. S. dollars per barrel was unchanged ($2.23) prior to September 1, 1970. The realized price per barrel was decreasing, especially when independents started their sales of oil in the sixties. The realized price (as industry average) amounted to $2.19 in 1961, $2.01 in 1962, $1.95 in 1963, $1.93 in 1964 and $1.77 in 1965 (42, p. 177). So the revolutionary authority started putting pressure on oil companies and claiming that Libyan oil was priced too low with respect to its production cost, its high quality because of low sulphur content, and its nearness to markets. That is, Libya held a strategic position among the oil exporting countries of the area. When a price increase of 40 cents a barrel was demanded, the oil companies rejected such an increase. However, dishonest oil companies continued to play the game of prices between them and the host-oil producing countries. Blair (9, p. 221) indicated

> . . . the companies in dealing with the Libyans discounted the value of low-sulphur content, whereas in dealing with the Venezuelans, whose oil is notoriously high in sulphur, their position was reversed. In Aken's words: "they [the companies] were telling the Libyans, as I recall, that the low-sulphur quality of their oil gave them something on the order of a 10-cent price differential on the gravity side just for sulphur, and at the same time the Venezuelans told us that the companies were telling them that their oil, because of the high-sulphur content, was worth some 50 to 70 cents less than Libyan oil."

However, the revolutionary government policy is not only to obtain what it feels is a fair oil price,[2] but also to enter into production sharing agreements and to acquire majority ownership in the existing operating companies. Therefore, posted prices started rising for the first time on September 1, 1970 by 30 cents and continued rising annually as shown in Table III, reaching a level of $18.17 on May 1, 1978 then decreased to $13.85 in December 1978. In 1979 posted prices resumed its upward trend to reach $29.95 in December 1979 and $34.67 on January 1, 1980.

By the end of 1973, BP-Hunt, Amoseas and Shell Companies were wholly nationalized. Their estimated reserves in January 1970 amounted to 9.5 billion barrels per day, or 32.5 per cent of total reserves (29.2 billions b/d).[3] In the other companies such as Mobil-Gelsenberg, Exxon, Oasis and Occidental, only 51 per cent of their assets were

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[2]That is, a higher price which is associated with the effective increasing demand for oil.

[3]Based on one year.

TABLE III

POSTED (TAX REFERENCE) PRICES FOR 40^{o} API CRUDE OIL IN U. S. DOLLARS PER BARREL

Date	Posted Price	Date	Posted Price	Date	Posted Price
Prior to Sept. 1, 1970	2.230	April 1, 1973	4.024	Oct. 1, 1975	16.060
Sept. 1, 1970	2.530	June 1, 1973	4.252	July 1, 1976	16.350
Jan. 1, 1971	2.550	July 1, 1973	4.416	Jan. 1, 1977	18.250
Mar. 20, 1971	3.447	Aug. 1, 1973	4.582	July 1, 1977	18.780
July 1, 1971	3.423	Oct. 1, 1973	4.604	Jan. 1, 1978	18.340
Oct. 1, 1971	3.399	Oct. 19, 1973	8.925	May 1, 1978	18.170
Jan. 1, 1972	3.386	Dec. 1, 1973	9.061	Dec. 1, 1978	13.850
Jan. 20, 1972	3.642	Jan. 1, 1974	15.768	Jan. 1, 1979	14.690
July 1, 1972	3.620	Apr. 1, 1975	15.000	July 1, 1979	23.450
Jan. 1, 1973	3.777	June 1, 1975	14.600	Dec. 1, 1979	29.950

Sources: (1) Recent Economic Development in Libya, IMF Staff Report, 1978;
(2) M. Attir, Trends of Modernization in an Arab Society (2),
(3) Central Bank of Libya, Annual Report 1979. (25)

nationalized (9, p. 228). The national Oil Corporation which is established and owned by the state, is currently holding the government ownership in these oil producing companies. Prior to 1974, all oil production was exported except about 17 thousand barrels per day used by the Esso refineries for domestic consumption and for oil field operations. A new refinery, with 60 thousand b/d capacity, was completed in 1974 at Zawai town. It is designed to serve both domestic consumption and the export market especially when its capacity was doubled in 1977. However, the development of refineries in Libya may be reflected by the increase in that part of production which is not exported, amounting to 2 per cent of total production in 1974, 3.3 per cent in 1975, 4.4 per cent in 1976 and 5.9 per cent in 1977. Therefore the oil by-products received a great deal of attention when planning is introduced to the petroleum industry, so that exports of petroleum products, such as naphtha, LGN, fuel oil, gas and kerosene, increased very rapidly in value from L.D. 56.5 million in 1974 to L.D. 97.5 million in 1975, L.D. 115.4 million in 1976 and L.D. 176.6 million in 1977 (26, p. 17). The government action is reducing production serve both to conserve this valuable single asset and to increase prices further, especially since it is appropriate to assume that the world demand for oil was relatively inelastic in the short run. The cut back in production is justified by that crude oil being a depleting resource. Thus it appears in Table IV, the quantity of oil production was decreasing during the period 1971-1975, then it resumed its increase during 1976 and 1977. The average annual growth rate of oil production was changed from a positive rate of 55.28 per cent during the first period (1962-1969) to a negative rate of 8.36 per cent during the later period. If the period (1971-75) is concerned, the

TABLE IV

THE PERCENTAGE RATE OF GROWTH OF THE VARIABLE

	RY	ROY	RYP	QX	P	Ph	RW	OPX	L	(RYP/L)	RG
1962	27.46	-	-	-	4.72	4.87	-	-	-	-	-
1963	37.10	145.74	8.28	142.36	6.66	6.87	19.98	0.00	1.10	7.10	6.43
1964	26.61	95.36	23.75	94.52	0.58	6.33	20.90	0.00	6.63	16.06	81.49
1965	33.81	29.95	23.76	41.50	6.21	5.58	17.08	0.00	9.28	13.25	114.50
1966	13.04	15.99	10.48	23.85	13.67	25.90	4.42	0.00	3.78	6.46	38.18
1967	8.65	5.99	16.13	14.90	6.65	22.04	11.12	0.00	3.58	12.12	45.95
1968	36.27	61.38	22.97	50.60	-0.15	-6.82	35.07	0.00	0.62	22.22	9.84
1969	8.04	-23.56	44.17	19.25	10.48	14.83	1.12	0.00	-1.23	45.96	-27.78
1970	-0.13	40.17	-33.45	6.75	5.85	-25.30	-1.42	0.00	1.86	-34.67	23.04
1971	31.08	16.97	43.97	-11.59	-2.99	6.17	52.54	25.00	4.45	37.83	74.81
1972	7.36	-0.92	25.65	-23.45	0.26	10.47	-6.20	4.00	7.02	17.41	60.04
1973	18.14	14.63	17.95	-3.14	7.12	31.19	39.09	42.31	0.45	17.42	-2.77
1974	62.31	95.31	31.25	-30.05	8.11	11.75	6.64	200.00	26.05	4.12	93.58
1975	-9.08	-24.11	4.94	-2.73	8.80	13.64	4.53	-9.91	1.33	3.57	-2.02
1976	24.77	33.45	12.10	30.96	5.08	0.59	5.27	6.00	5.34	6.42	15.76
1977	13.15	14.21	7.83	6.47	6.66	-4.09	17.50	13.21	3.82	3.86	8.53
Average (62-69)	23.87	41.36	21.36	55.28	6.10	9.95	15.67	0.00	3.39	17.60	38.37
Average (69-77)	17.29	19.46	17.16	-8.36	5.49	6.58	13.23	31.18	5.45	11.32	27.02

Note: RY = real GNP; ROY = real GDP in the oil sector; RYP = real GDP in the non-oil sector; QX = quantity of oil production; P = the consumer price level and Jan. 1964 is the base; Ph = price index of rents; RW = real wage; OPX = price index of oil exports; L = labor force; (RYP/L) = labor productivity; RG = real development expenditure by the government.

average negative rate of growth in oil production amounted to 14.19 per cent per annum. But oil posted prices rose by an annual average of 31.18 per cent during the later period compared to zero in the first period. So oil revenue to the government continued to rise as the price increases overweighed the reduction in oil production; that is, oil revenue has been increased from an annual average of L.D. 177.9 million during the first period to L.D. 1122.6 million during the later period. The non-oil revenue in the budget remained very small, it is less than 20 per cent of the total budget revenue.

Real gross domestic product in the oil sector shows a lower annual average rate of growth (19.46 per cent) during the later period compared to that (41.36 per cent) of the first period. But with respect to employment in oil producing companies, it shows only small annual changes, as its annual average size increased from 5724 workers during the first period to 6619 workers during the later period, of which foreign workers constitute about 34.2 per cent in the first period and 29.6 per cent in the later period. However, this sector does not absorb so much of the labor force, as oil is capital intensive industry, and as evidenced from data, the above mentioned employment size constitutes only 1.3 per cent of the labor force during the first period, and decreased to 1.1 per cent during the later period. With respect to wages, oil companies pay a higher wage rate than any other company in the economy, especially those Libyans with higher managerial talent or with higher levels of technical skills.

The Non-Oil Sector

The Government's Main Objectives

Taking into account that crude oil is a depleting asset, the government attempted to achieve its two main objectives concerning the structure of the economy; these are to diversify the economy on one hand, and to reduce the economy's dependence on this single asset. Thus the revolutionary government allocated a huge development plan during the later period, of which the annual average of actual development expenditures amounted to L.D. 614.3 million compared to only L.D. 70.3 million during the first period. But in real terms, development expenditures grew by an annual average of 38.37 per cent during the first period and 27.02 per cent during the later period. Here it is likely to note that the higher rate of growth during the first period arose from the fact that such expenditures were relatively small compared to those absolute values spent during the later period. In these expenditures there were three negative rates of growth. First, the highest reduction of 27.8 per cent in 1969 arose from the fact that the revolutionary authority which came about on the first of September 1969 stopped most projects in the plan for reexamination, while the second negative rate of 2.77 per cent and third negative rate of 2.02 per cent occurred in 1972 and 1975, respectively, as a result of some socialistic actions taken by the government, on one hand, and of the limited absorptive capacity on the other. Because of that reduction in development expenditures in 1969 and some other government actions in 1970, the later year had witnessed a recession; that is real output in the non-oil sector decreased by one third, but because of the huge increase in the real output of the oil sector, the decrease in real GNP was not felt as it was about one tenth of one per cent. In fact the annual average of output growth amounted to 21.36 per cent during the first period compared to 17.16 per cent during the later period. 1975 witnessed also a higher rate of recession as the level of real GNP decreased by 9.1 per cent in this year, resulting from the high rate of reduction (30.1 per cent) in oil production of the preceeding year, and the oil price reduction by 9.91 per cent in 1975.

Prices

Table IV shows the percentage rates of growth in the consumer price level (P) and in the price index of rents (Ph), while the imported inflation through the import prices of consumer goods (PMC) and the import prices of capital goods (PK) are shown in Table VI. Therefore, a glance to these tables shows it is likely to note that the annual average rate of inflation is lower during the later period, despite the world inflation was creeping rapidly during this period. To curb the upward pressures on the general consumer price index, the revolutionary government established the National Supply Corporation which has exclusive import rights over various food stuffs, namely, sugar, salt, wheat, barley, flour, rice, olive and vegetable oils, tea, coffee and tomato paste. The prices of these commodities are fixed at the 1972 price level and the difference between buying and selling prices is financed by the government as subsidy for curbing inflation especially in important food stuffs. This policy aims also that the low-income group shall not be affected by inflation. The subsidies have risen very rapidly from L.D. 79 thousand late in 1971 to L.D. 5.3 million in 1972, L.D. 12.6 million in 1973, L.D. 43.3 million in 1974, L.D. 74.7 million in 1975 (10, 43), L.D. 40 million in 1976 and an estimated L.D. 42 million in 1977. In addition, the imported meat is also subsidized so that meat prices decreased by 30 per cent and 25 per cent during the second and third quarters of 1974[4].

The National Supply Corporation buys also some supplies such as olive oil and wheat from farmers at prices favorable to them; that is because they cannot compete with those reduced prices of similar imported goods. The farmers also receive some subsidies for production ranging from 25 per cent to 50 per cent of the purchase value of machinery by the government through the Agricultural Bank. These subsidies were less than one million in each year in the late sixties (6, p. 155), then increased considerably to an annual average of L.D. 18.2 million during the period 1973-77. However, total subsidies as shown by national accounts have shown an annual average of L.D. 55.2 million during the later period, against only L.D. 4.0 million during the first period. There are also some price control measures which were introduced at the end of 1969, aiming to decrease the upward pressures on domestic prices. In general all these measures including subsidies may insulate consumers and farmers from international market price fluctuation, but such measures are justified by assisting the low-income group on one hand, and curbing the upward pressures on wages on the other. The index number of housing rents is also affected by different measures which has been taken by the government such as reducing rents by 30 per cent in December 1969 and another rent reduction by 30 per cent in May 1976, for all rental contracts conducted after August 1972. In addition, more free interest loans have been given to the middle class and low income groups for building their own

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[4]See Al-Jihad Newspaper, July 29, 1977. Tripoli-Libya.

houses, which aims to decrease the upward pressures on rents.

With respect to the index number of housing rents, it grew by an annual average of 9.95 per cent during the first period, against only 6.58 per cent during the later period. There was a negative rate of growth in this index of 6.82 per cent in 1968 resulting partly from the 1967 war between Israel and three Arab states when some Jewish citizens emigrated. Another negative rate of growth occurred in 1970 as a result of the rent reduction on one hand, and that all Italian settlers[5] had left the country on the other. These reductions were reflected also in the general index number of prices, as the latter has shown a little reduction of 0.15 per cent in 1968 and a higher reduction of 2.99 per cent in 1971. While the little increase of 0.59 per cent in housing rents index in 1976 and a reduction of 4.09 per cent in 1977 resulted from the rent reduction of 1976 and other measures concerning the supply increase of houses. However, all anti-inflationary measures have succeeded partly in reducing the inflationary trends compared to imported inflation.

Employment and Wages

The growth rates of labor force (L), real wage (RW) and labor productivity (RYP/L) are shown in Table IV. According to estimated data of labor force released by the Ministry of Planning from time to time, employment has increased more rapidly during the later period than that of the first period as a result of huge development

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[5]Colonel Qadhafi forced on October 7, 1970 those Italian settlers who belonged to the Italian Facist era to leave the country. In Dr. Attir's (2, p. 9) words "...a drama which had lasted for more than a century, ended."

expenditures during the later period. That is, the annual average rate of growth of the labor force increased from 3.39 per cent during the first period to 5.45 per cent during the later period. There was only one negative rate of growth in employment during the whole period; it was 1.23 per cent in 1969, resulting from a reduction of 27.8 per cent in real development expenditures in 1969. The productivity of labor was increasing at a reasonable level as a result of the annual considerable augmented capital on one hand and the heavy plan for training workers on the other. The annual average rate of growth in the average productivity decreased from 17.6 per cent during the first period to 11.32 per cent during the later period. This decrease may have arisen from the first year of the revolution as a transitional year, in which the revolutionary government reexamined the development expenditures, and consequently, these expenditures were slowed down during 1970. In addition, responsibilities were withdrawn from the top administrative persons in the government and given to the second line of employment with a lower level of experience, as priority is given to confidence rather than experience. Therefore, there was a decrease of 34.67 per cent in productivity in 1970. A part of this decrease may be due to a decrease of 1.42 per cent in real wages during the same year.

The foreign labor force working in Libya constituted an annual average of 7.94 per cent of total labor force during the first period compared to a higher average rate of 22.06 per cent during the later period. This higher percentage of foreign labor force is due to the huge development plans conducted since 1972. During the period 1975-1977 alone, foreign workers constituted one third of the total labor force in Libya, as a result of the current development plan-allocation and expenditures, which its recent revision amounted to L.D. 9350 million of which 13.1 per cent is allocated for industry and mining, 11.8 per cent for housing, 11.2 per cent for land reclamation and 10.0 per cent for electricity (22, p. 74), so that the demand for foreign labor is increased very rapidly as the domestic supply of labor shows shortages even in the non-skilled labor; consequently such non-skilled labor is also imported from neighboring countries.

Therefore, if unemployment is defined as a situation in which there are no jobs for those who want to work, then unemployment in Libya is not a serious problem facing its economy, especially in the seventies where even demand for unskilled labor exceeds its supply, so that foreign unskilled workers are imported and their participation in constructional and agricultural activities is observable. But the problem of unemployment in Libya is typical of less developed countries and differs from that of the advanced countries. In Libya according to traditions and customs, female participation in the total labor force is very low, amounting to 3.5 per cent ot total female population in mid-1973; that is including non-Libyan females. However, in 1975 Libyan female participation constituted only 5.2 per cent of total female partitipation in the labor force (20) Most female labor is engaged in the education sector as teachers in girls schools, and some women living in the rural areas may operate farms in cooperation with their husbands. In general, women in Libya are still operating in the home where their services are not included in the national product accounts. Therefore it is reasonable to expect a high proportion of people who can work are not employed in economic activities. Another kind of unemployment in Libya is disguised unemployment particularly in the government administrative departments and in the trade sector. That is, if a number of workers were removed from these two sectors, the output of services would not be affected. However, the government started in 1979 to introduce large commercial centers and to eliminate individual business, seeking that such disguised unemployment become eliminated from this sector. So the main ojbective is a higher rate of participation in the productive labor force and a higher rate of productivity. The target of higher productivity became a priority in recent years, as arisen from official announcements, but some government actions concerning motives contradict this target; and hence it seems not to encourage increasing productivity. Table IV shows that productivity is increasing faster than that of real wages during the first period, while the opposite becomes the case during the later period. That is, real wages increased by an annual average of 13.23 per cent during the later period against an increase of 11.32 per cent in labor productivity during the same period. This means that the revolutionary government played a favorable role in the labor force.

The minimum daily wage was fixed at L.D. 0.5 before 1969, then this minimum level was doubled in 1970, so that there was a sharp increase in wages for unskilled labor, despite the 1970 data showing a reduction in real wages, but a high rate of increase (52.54 per cent) in 1971. Salaries of civil servants were increased by 60 per cent in late 1964 and since then rose by an annual rate of about 3 per cent up to 1974. In addition, monthly housing allowances ranging between L.D. 50 and L.D. 100 was provided in 1969. Because of the continuous increase in prices at an annual average of 5.5 per cent during the later period, the Ministry of Labor and Civil Service studied the prevailing standard of living in 1970 and found that the prevailing average wage is "considered lower than the requirements of the standards of living due to the increase in cost of living" (18, p. 83), and found that the minimum income is reasonable for an average worker's family should not be less than L.D. 120 per month, while the average monthly income of Libyan civil servants is L.D. 68 as reported by the Central Department of Administrative Control in 1972. Thus there are pressures from those competent officials on the government authorities to raise the level of wages and salaries in order to offset those increases in the cost of living. Therefore, in April 1974, salaries of civil servants were increased by 25 per cent, while the rate of inflation registered a rise of 69.3 per cent during the mentioned decade. However, these salaries were raised again by between 8 and 15 per cent in January 1975. Minimum wages were also increased to L.D. 1.350 in 1972 (19, 84), L.D. 1.750 in 1974 and L.D. 2.00 in 1975 (22). But it is felt that the prevailing wages are above those fixed levels especially in the case of skilled labor in all sectors and most of unskilled labor in the private sector.

The Balance of Payments

Table V summarizes the identity of the balance of payments ($\Delta NFA = NX - 1M \pm NS \pm NK$). The Libyan balance of payments is characterized by a surplus during the period under review, except three years, namely 1973, 1975 and 1978, in which a considerable deficit appeared amounting to L.D. 316.0 million in 1973, L.D. 509.3 million in 1975, and L.D. 133.4 million in 1978. However the annual average surplus in the Libyan balance of payments amounted to L.D. 36.65 million during

TABLE V

THE BALANCE OF PAYMENTS ($\Delta NFA = NX - 1M \pm NS \pm NK$) (AMOUNT IN L.D. MILLION)

	Oil Sector	Non-Oil Sector			Monetary Sector
	NX	1M	NS	NK	ΔNFA
1962	33.70	48.64	-2.36	+18.30	1.00
1963	58.50	60.88	-5.02	+17.10	9.70
1964	89.30	76.23	-3.62	+8.60	18.00
1965	132.10	92.62	-13.28	+1.10	27.30
1966	184.80	130.56	-30.04	+8.00	32.20
1967	226.60	138.44	-36.76	-36.90	14.50
1968	329.40	174.62	-56.28	-44.40	54.10
1969	484.80	187.20	-81.80	-79.40	136.40
1970	583.20	166.10	-94.70	-75.20	247.20
1971	733.90	230.93	-140.17	-53.60	309.20
1972	666.00	324.90	-227.50	-25.70	87.90
1973	755.50	525.50	-262.90	-283.10	-316.00
1974	1840.20	802.30	-525.10	+114.00	626.80
1975	1433.20	1021.20	-573.80	-347.50	-509.30
1976	2152.80	928.40	-620.60	-264.40	339.40
1977	3003.20	1071.63	-997.47	-386.70	547.40
1978	2548.48	1362.57	-756.83	-562.48	-133.40
Annual Average					
1962-69	192.40	113.65	-28.65	-13.45	36.65
1969-78	1420.12	662.08	-428.08	-196.40	133.56

Note: NX is net surplus of the oil sector.
1M is imports as given in foreign trade data, and the difference from that given in the BOP is included in net services.
NS is net services which is net imports of services. It includes the above mentioned difference and domestic exports and reexports which mostly were made by Libyan travellers and foreign workers going back to their home countries.
NK is net capital flow, the negative sign means outflow of capital, and positive sign means inflow of capital. Errors and omissions are included in NK.
ΔNFA is change in net foreign assets or the foreign reserve flow. The negative sign denotes a deficit in the balance of payments, a positive sign denotes a surplus.

the first period compared to L.D. 133.56 million during the later period, a rise of 264 per cent. But if net exports in the oil sector are taken into account the mentioned average surplus was shrinking with respect to rapid growth in oil net exports. The ratio between annual average surplus and annual average net exports decreased from 19.05 per cent during the first period to 9.41 per cent during the later period. That is to say, the absorptive capacity is higher in the seventies so that deficits rose in three years. The large decreases in oil net exports during the years 1972, 1975 and 1978 are partly responsible for the above mentioned deficits, while the other part is resulted from the increase in absorptive capacity of the non-oil sector, especially the huge increase in imports of capital goods. Real imports of capital goods showed an annual growth rate of 14.10 per cent during the first period against 23.51 per cent during the later period. But real net exports of the oil sector showed a higher annual rate of growth (38.66 per cent) during the first period, resulting from a rapid increase in oil quantity of production with a constant posted oil price, against a lower annual rate of growth (37.07 per cent) during the later period, resulting from a huge decrease in the oil quantity of production, and a huge increase in the posted oil export prices.

The breakdown of real total imports into consumer goods (RMC) and capital goods (RMKP) imported by the non-oil sector are shown in Table VI in terms of rates of growth. In regard to real imports of consumer goods, they showed an average rate of growth of 16 per cent during both periods, but the later period witnessed three negative rates of growtn in real imports of consumer goods. The first two

TABLE VI

GROWTH RATES OF THE VARIABLES (PER CENT)

	RMC	RMKP	RNS	RNX	PK	PMC	E	ES
1962	-	-	-	-	-	-	-	-
1963	22.28	12.29	99.43	62.75	1.14	2.83	0.22	0.20
1964	27.91	20.85	-28.30	51.77	2.25	1.83	0.14	0.30
1965	10.07	19.35	245.41	39.28	3.40	2.10	-0.27	-0.10
1966	15.71	33.07	99.00	23.07	1.06	1.67	-0.12	0.10
1967	18.54	-18.70	14.74	14.98	4.31	0.87	-0.38	0.0
1968	25.33	27.70	53.33	45.58	-8.26	-1.05	-1.90	-0.40
1969	-8.21	4.17	31.56	33.22	-2.20	3.47	-0.47	0.30
1970	-2.77	-32.22	93.71	13.65	14.93	4.76	0.72	-0.10
1971	30.47	65.34	52.57	29.71	12.99	5.52	0.06	-1.48
1972	17.91	70.68	61.88	-9.49	12.36	9.37	-0.47	-6.70
1973	40.49	60.82	78.80	5.90	16.54	25.69	-2.00	-8.54
1974	38.04	43.82	84.75	125.30	11.49	19.71	-4.45	-1.29
1975	15.35	18.28	43.72	-28.42	21.79	9.54	4.42	0.0
1976	-6.12	-19.12	29.27	42.95	7.00	-0.98	-10.33	0.0
1977	17.71	-0.20	50.69	30.79	10.22	9.60	0.31	0.0
Average (62-69)	15.99	14.10	73.60	38.66	0.24	1.67	-0.40	0.06
Average (69-77)	15.87	23.51	58.55	27.07	11.68	9.63	-1.36	-1.98

Note: RMC = real imports of consumer goods (in 1964 dinars); RMKP = real imports of capital for the non-oil sector; RNS = real net imports of services, RNX = real net exports of the oil sector; PMC = price index (1964 = 1.0) of imports for consumer goods; PK = price index of capital imports; ES = the exchange rate of U. S. dollars in terms of home currency, E = the exchange rate index in terms of home currency.

rates occurred in 1969 and 1970 as the revolutionary government economic policy appeared to be more restrictive with respect to the private sector, and the third negative rate of growth occurred in 1976, where a revolutionary action was taken toward socialism. However these shortages were covered during the following years; that is, the rate of growth in real imports of consumer goods amounted to 30.5 per cent in 1971 and 17.7 per cent in 1977.

Real imports of capital goods showed also four annual negative rates of growth, the first one was in 1967 (-18.7 per cent) resulting from the disturbance of the June fifth war between Israel and Arab states; the second rate was in 1970, and the late two rates were in 1976 and 1977, resulting from the same causes mentioned above, affecting real imports of consumer goods.

Net real imports of services registered a higher rate of growth, amounting to 73.6 per cent as an annual average during the first period, compared to 58.6 per cent during the later period (see Table VI). Net real imports of services and net capital outflow showed an annual average of L.D. 28.65 million and L.D. 13.45 million, respectively, during the first period compared to a higher average of L.D. 428.08 million and L.D. 196.4 million during the later period. However, it is likely to note that the sum of net imports of services and net capital outflow exceeds, for the first time, total imports of goods by 29 per cent in 1977, while they were lower than total imports of goods in most years of the period under review, except in 1970 and 1973 in which the increase amounted to 2 per cent and 4 per cent, respectively.

The exchange rate index (E) of the Libyan Dinar (L.D.) in terms of home currency showed a small increase during 1963 and 1964, and a small annual decrease during the years 1965-1969, reflecting the strength or weakness of the pound sterling, inasmuch as the Libyan Dinar is linked to the pound sterling (see Table VI). The largest fall in the exchange rate during the first period was in 1968, as a result of the pound sterling devaluation in November 1967, so that the Libyan Dinar was appreciated by 1.9 per cent against those foreign currencies with which Libya had a trade relationship. When the pound sterling became unstable on one hand, and Libya had withdrawn from the pound sterling area in December 1971, on the other, the monetary authority chose the U. S. dollar as the intervention currency for the Libyan Dinar, so that once more the Libyan Dinar reflects the strength or weakness of a foreign currency, especially if the daily rate of exchange toward this foreign currency is kept constant. Only official changes in the value of the U. S. dollar are considered, so that the Libyan Dinar was appreciated by the same value of the dollar devaluation. However, the Libyan Dinar was appreciated vis-a-vis main key currencies by 0.47 per cent in 1972, 2.0 per cent in 1973 and 4.45 per cent in 1974. But a depreciation of 4.42 per cent occurred in 1975 and an appreciation of 10.33 per cent also occurred in 1976, reflecting the improvement gained by the U. S. dollar vis-a-vis other main currencies. However, in general, the exchange rate index as expressed in terms of the amount of domestic currency exchanged per unit of foreign currency, showed an annual average appreciation of 0.40 per cent during the first period against 1.36 per cent during the later period. That is the Libyan Dinar did not follow devaluations of some foreign currencies. So that this decrease in the foreign exchange rate index makes imported goods cheaper in terms of the

Libyan Dinar and exported commodities more expensive in terms of the foreign currency. But in the case of Libya, the Libyan Dinar appreciation did not harm exports, as these exports are wholly crude oil and sold in terms of U. S. dollars. Thus the above mentioned appreciation of the Libyan Dinar will contribute to a decrease in the level of imported inflation, but the reduction in the imported inflation is smaller when foreign prices also rise as a result of devaluation, and hence an offsetting effect may occur, on the price level in the appreciating country.

The depreciation of the dollar in 1977 and 1978 is reflected in depreciating the Libyan Dinar by 0.31 per cent in 1977 and 8.06 per cent in 1978. But a question may arise, why the U. S. dollar is chosen by the Libyan monetary authority to be used as the intervention currency? If an intervention currency is necessary for the Libyan Dinar, why was the choice not set on a stronger and more stable currency, such as the Mark of West Germany. In fact, Libya's earnings of foreign exchanges are wholly in dollars from oil exports, and hence most Libya's reserves are also invested in dollar assets on which a higher rate of interest may be obtained. So that if the Mark was chosen as the intervention currency for the Libyan Dinar, the Central Bank of Libya may suffer some losses when such earnings of dollars are converted into Mark assets on one hand, and because of lower rate of interest paid on the latter assets, on the other hand. Therefore, given the economic conditions in Libya, the choice of the dollar as the intervention currency for the L.D. is appropriate as far as the dollar is still convertible into other reserve assets.

The policy of appreciating the Libyan Dinar vis-a-vis foreign currencies helps to reduce the level of imported inflation, so that domestic inflation is kept lower than imported inflation. The imported inflation through consumer goods showed an annual average of 1.67 per cent during the first period against 9.63 per cent during the later period. While imported inflation through capital goods showed a higher annual average of 11.68 per cent during the later period against a lower annual average of 0.24 per cent during the first period (see Table VI). So that domestic inflation averaged annually at only 5.49 per cent during the later period, as a result of those anti-inflationary policies, compared to 6.10 per cent during the first period (see Table IV). That is actual domestic inflation which is higher than world inflation during the sixties, resulting from the absence of anti-inflationary policies, is lower during the later period, because of those anti-inflationary policies such as currency appreciation, subsidies for reducing prices of food stuffs and some agricultural capital goods, and other measures of price control and profit sealings.

New Developments in the Libyan Economic System

Early in 1978, Colonel M. Al Qadhafi issued part two of The Green Book which deals with the solution of the economic problem. A new socialism is indicated as being the real solution to the economic problem, and may be summarized as follows:

A man is free if he possesses the house in which he lives, the vehicle to be used for his transportation, and an income by which he may satisfy his other (material) needs. That is, because "in need freedom is latent". A man cannot be a wage earner because someone else would then control his income. The Green Book considers the relation between employers and employee as slavery. Therefore, the real solution is to abolish the wage-system, "emancipate man from its bondage and return to the natural law". Thus the actual producer (worker) should be a partner in the process, sharing equally in what is produced. The income is wholly derived from what is produced. Servants in houses are another type of slavery, so they must be liberated and to be transformed into partners outside the house. "The house is to be served by its residents."

Concerning the primary need of housing for each family, no one has the right to build an extra house for in renting property he would be controlling the primary need of that family. But, in general, the Green Book considers the purpose of the socialist society as "the happiness of man which can only be realized through material and spiritual freedom." "For man to be happy he must be free, and to be free, man must possess his own needs." The purpose of the individual's economic activity is solely to satisfy his material needs, it is not to create a surplus for investment to gain a profit. When a profit exists, it means there is exploitation. Thus, "the final solution is the abolition of profit." However, savings are allowed if they are from a man's needs, and not from the efforts of others. "The savings which are in excess of one's needs are another person's share of the wealth of society." But after all, when the material needs of a society are satisfied, profit and money will eventually disappear.

Now then some of the mentioned principles were applied in Libya during the second half of 1978 and during the year 1979, so that it is expected that our econometric monetary model may not be able to make good forecasts for some variables during the transitional years.

CHAPTER IV

THE MODEL AND ITS STRUCTURE

This chapter derives a monetary macro econometric model to the Libyan economy in particular and to the oil exporting countries in general, with a special emphasis on the balance of payments. Particular attention is given to the money demand function because of its effect on the balance of payments.

Demand for Money

Following Klein (61, p. 933) the money demand function may be written as:

$$\left(\frac{M}{P}\right)^d = f\left(\frac{Y}{P}, RM, RS\right)^1 \qquad (1)$$

where $(\frac{M}{P})^d$ is demand for real money balances, $(\frac{Y}{P})$ is real income, RM is the rental price of the monetary service stream from a unit of money, or it is as the own price of money. RS is the rental price paid for the monetary service stream from a unit of money substitutes, or it is as the cross price of money. The rate of interest in Libya is fixed at a constant level since 1963, so it is not appropriate to

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[1] Its derivation is based on the individual utility constrained maximization as shown in Chapter II (p. 11-13).

be taken as proxy for the own price of money. The real rate of return on money is the opportunity cost of holding money in terms of goods, so it is likely to define such real rate as the rate of inflation (108, p. 62).

$$RM = \frac{1}{P} \cdot \frac{dP}{dt} \tag{2}$$

With respect to money substitutes, the prople of most developing countries prefer to hold their wealth in the form of housing for two reasons: (1) the rate of return is satisfactory; (2) holders of such assets may easily obtain credits from banks as people have mortgage guarantees. This is the case also in Libya, as the holders of buildings and houses may easily get the monetary services guaranteed by the housing assets. Then similarly it is reasonable to consider the rate of inflation in the prices of housing building materials as proxy for the rental price of monetary service stream from a dinar's worth of money substitute. Thus the cross price of money is

$$RS = \frac{1}{Ph} \cdot \frac{dPh}{dt} \tag{3}$$

Now concerning signs of the money demand function, they are as follows: $f1 \geq 0$, $f2 < 0$, $f3 > 0$. It is likely to note according to Klein (61, p. 933) that the positive relationship between RS and demand for money is due to the assumption that the substitution in production effect dominates any scale of production effect.

According to Lieberman (74, p. 309), the coefficient of the interest rate in money demand analysis reflects not only the opportunity cost of holding money but also the induced improvement technology which tend to reduce demand for money, especially to reduce demand for currency in the case of Libya. Therefore it is useful to introduce an explicit technological change variable in order to assure the pure effect of the opportunity cost of holding money.

In the case of Libya, it is possible to consider the actual development expenditures as a proxy for the technological change variable, and if it is not appropriate in some cases, a time trend may be considered, as was done by Lieberman.

The technological change proxy (RG or T) is negatively related to demand for money, because improvement in technology leads to a reduction in the real cost of transactions in managing money balances. But in the case of Libya the improvement in communication and transportation between cities and villages in the country leads to reduced cash holdings of households and small business firms. In addition the development of such facilities induces more businesses to participate in investment and hence reduces their deposits at the commercial banks.

The importance of this variable is not only to avoid the interdependence between the opportunity cost of holding money and the technological change variable, but also to gain stability in money demand equations. Thus it is preferable to add a technological change measure to equation (1). While Cargill and Meyer (17, p. 322) indicated that to get an unbiased test of money demand stability, and to improve the explanatory power with in the sample one has to consider the theoretical arguments which imply a time-varying response of the money demand function to income and opportunity cost changes. But since the recent empirical evidence supports the existence of a short run and a long run stable money demand function, it is preferable to ignore this issue in order to minimize the cost of estimation procedures.

Then it is found, by including a lag, that improvements have been made in estimating the appropriate parameters of money demand function, and it is recognized that the various elasticities of demand for money are lower in the short run than in the long run as indicated by White (106, p. 564). He also insisted that inflation becomes the strongest influence in creating discrepancies between desired and actual holdings of monetary assets; he argued that a revision of the conventional stock adjustment models[2] should be used under inflationary conditions. That is, there is an error under the assumption that $\overset{*}{mt} = m_{t-1}$, but $Pt > P_{t-1}$, therefore desired and actual money are equal by definition, so there is no need for stock adjustment process, but White (106) indicated that this equality is irrelevant, since the price rise means that the value today of past period's nominal money stock has fallen below today's desired level. Therefore a new flow of money whether measured in nominal or in real terms must be generated (p. 569). So he calls for the correction of the conventional adjustment coefficient[3], as this misspecification causes a bias in the estimated coefficients.

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[2]These models written in log:

using nominal values: $\ln Mt - \ln M_{t-1} = \gamma (\ln \overset{*}{Mt} - \ln M_{t-1})$ (1)

using real values: $\ln mt - \ln m_{t-1} = \gamma (\ln \overset{*}{mt} - \ln m_{t-1})$ (2)

[3]Equation (2) in footnote (2) is valid if it is assumed that lagged stock adjustment applied to changes in real income and other variables including inflation rate, and even if stock disequilibrium is caused by a change in the price level, there is no need for the adjustment lag.

Thus from the above analysis, it is preferable to include a lagged stock variable to improve the explanatory power of the regression and to improve the estimates of the appropriate elasticities of demand for money with respect to the independent variables. The lagged dependent variable must have a positive sign. It is assumed that the adjustment coefficient is between zero and one for purposes of stability.

Finally it is important to consider the impact of implementing the economic social system which arose with the First September Revolution, 1969, as it began a series of economic social measures leading to a tightened government and public control over industry, commerce, banking and foreign trade. Therefore it is expected that people tend to hold their assets mostly in liquid form as money; therefore a dummy variable is useful to capture the above mentioned impact. This dummy variable (DR) is expected to have a positive sign, since the expected impact is an increase in demand for money holdings during the second

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White (106) shows this fact by converting equation (2) into nominal terms by addition of ($\ln Pt - \ln P_{t-1}$) to both sides:

$$\ln Mt - \ln M_{t-1} = \gamma\ (\ln mt^{*} - \ln m_{t-1}) + \Delta \ln Pt \qquad (3)$$

But converting (1) into real money terms:

$$\ln mt + \ln Pt - \ln m_{t-1} - \ln P_{t-1} = \gamma(\ln mt^{*} + \ln Pt - \ln m_{t-1} - \ln P_{t-1})$$

$$\therefore\ \ln mt - \ln m_{t-1} = \gamma\ (\ln mt^{*} - \ln m_{t-1}) - (1-\gamma)\ \Delta \ln Pt \qquad (4)$$

Then the corrected adjustment coefficient (γr) is:

$$\gamma r = \frac{\ln mt - \ln m_{t-1} + (1 + \gamma r)\ \Delta \ln Pt}{\ln mt^{*} - \ln m_{t-1}} \qquad (5)$$

Dividing equation (5) by the solution of equation (2) for γ:

$$\frac{\gamma r}{\gamma} = \frac{(1 - \gamma r)\ \Delta \ln Pt}{\Delta \ln mt} \qquad (6)$$

Then the direction of bias depends on the sign of $(\frac{\Delta Pt}{\Delta mt})$ and when $\gamma r = 1$, there is no bias.

period (1969-1977). Then another dummy variable is needed to capture the impact of government nationalization of buildings and houses (late 1975) which are financed by commercial banks under a special law calling for a "housing development" with a lower rate of interest (5.5%). So this dummy variable (D76) is expected to have a negative sign with respect to demand for deposits, and a positive sign with respect to demand for currency. The variable (DR) is equal to one for years 1969 and after and equal to zero otherwise, while the variable (D76) is equal to unit for 1976 and 1977 and zero otherwise. Thus the money demand function is specified as follows:

$$\left(\frac{M}{P}\right)^{d} = f\left[\frac{Y}{P},\ RM,\ RS,\ \left(\frac{G}{P} \text{ or } T\right),\ \left(\frac{M}{P}\right)_{t-1},\ DR,\ D76\right] \qquad (4)$$

and the expected signs are: f1, f3, f5, f6 > 0; f2, f4, f7 < 0. But it is reasonable to expect that the variable (D76) may be insignificant if the function is estimated in its aggregate model form, because the decrease in demand deposits may be offset by the increase in currency outside banks. However, it may be preferable to estimate the money demand function in its disaggregated model taking into account the same independent variables for two reasons: (a) to make a comparison between aggregated and disaggregated models based on the percentage error measure criteria. The model which has the lowest percentage error measure must be accepted as plausable to be included in the complete model; (b) some interesting information may be hidden when the aggregate model is estimated, while the disaggregated model may show this information obviously, so that they may become helpful to the monetary policy makers.

Even in the aggregated model, two definitions of money will be investigated:

1. The well-known narrow definition of money, that is currency outside banks (CC) plus demand deposits (DD) held by the public at the banking system. This is called (M1).

$$M1 = CC + DD \tag{5}$$

2. The well-known Friedman definition of money, that is M1 plus time and saving deposits (TS) of the public:

$$M2 = M1 + TS \tag{6}$$

Prices

After World War II, discussion of inflation centered on cost push and demand pull theories. That is, an autonomous rise in the factor costs leads to an increase in the price level, given a fixed level of aggregate demand. Similarly an autonomous rise in the aggregate demand leads to an increase in the price level, given a fixed level of factor costs. However a various approach to the inflationary phenomena has been offered by the proponents of the monetary and income expenditures approaches. This approach indicates that the price level may be explained as a function of cost factors, aggregate demand and an index of past price level changes (94, p. 32). But the aggregate demand is mainly a function of fiscal policy actions and monetary policy actions. However, Ron and Hunt (94) indicated that their results suggest there is a limited direct effect of monetary policy on prices, despite there being indirect effects through pressures on the level of resource utilization while the fiscal policy variable appeared to be very important (p. 37). This is mostly the case with respect to the developing economies, especially in Libya where the money is issued automatically when government increases its expenditures. If the latter is the case in Libya, then it is reasonable to consider money as a proxy for the aggregate demand variable. But this analysis does not take into account the degree of openness of the economy concerned. That is when the economy is open the domestic price is influenced not only by the monetary and fiscal policies actions at home, but also by the import prices[4]. And the import prices (PM) for a given importing country are export prices (FP) of other exporting countries to that country adjusted for the changes of exchange rate (E).

$$PM = FP * E \tag{7}$$

That is the import price in domestic currency is equal to foreign price of imports in foreign currency multiplied by the exchange rate given in terms of domestic currency. The transmission of inflation from one country to another has received a great deal of attention during the last decade. Thus when a country is involved in trading goods and services with another country, it is also involved in trading inflations, and its propensity to import inflation depends on its degree of openness. But only those tradable goods are subject to be influenced directly by the world inflation, because the non-tradables have only a domestic

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[4]Other studies support the idea that the import price is important in explaining the domestic price level, such as that of Clark (in Kwack (69)) who found the import price to be important in explaining the U.S. GNP deflator when it was used with the money stock and government expenditures. Kwack (69) also found that the coefficients on the import price variable were stable and significant in explaining U.S. deflator for consumption expenditures even in the presence of the money stock.

market, and hence they are mostly determined by domestic factors. However non-tradables may be indirectly affected as indicated by Laidler and Parkin (71, p. 783). But in the case of Libya, considering that housing is mostly a domestic good, it is partly influenced by the imported inflation through the imports of building materials.

Now utilizing the above discussion and concerning the case of Libya, the relevant independent variables may be specified for the general domestic price level function as follows:

$$P_t = P\ (Ph,\ PMC,\ E,\ M,\ P_{t-1}) \qquad (8)$$

where Ph is the price level of housing (or non-tradable goods), PMC is the foreign price of imports of consumer goods in foreign currency, E is the exchange rate of foreign currency in terms of domestic currency, M is the money to represent the pressure of aggregate demand for tradable goods or demand pull inflation, and P_{t-1} is the lagged price variable in order to see whether the desired price level is adjusted within the period or not. That is to say the domestic general price level is a function of imported inflation, domestic inflation and a demand pull inflation in the sector of the tradable goods. But also, it is preferable to add two dummy variables representing the large annual amount given as subsidy to the National Food Supply Corporation for reducing the market prices of such goods (DS), and the big changes in the foreign exchange rates of the main key currencies in 1971 and 1973 and their floatings since then (DE). Both variables (DS and DE) carry a value of one for the years after 1970 and zero otherwise. These dummy variables are used to correct the slope of the price of imports and the slope of the exchange rate with respect to their dependent variable (the price level). Therefore the dummy variable (DE) may capture the effects of changes in the exchange rate on the domestic price level, especially the official value of the Libyan currency vis-a-vis gold has remained unchanged since 1952. Hence, the devaluation or depreciation of some foreign currencies against gold, means an appreciation of the Libyan currency against those currencies. Consequently, a lower level of import prices may occur, and the latter leads to a lower level of domestic prices.

Indicating the fact that Libya is a small open economy so that the appreciation of its currency has a negligible effect on raising the prices in other countries on one hand, and its exports are sold in terms of dollars on the other, thereby there is no inflation to be exported to its partners in trade. But among the industrial countries, with which Libya is involved in trade, an appreciation of a currency against the dollar or the sterling pound, not only lowers that country's domestic prices, but also raises the prices of the other countries. Therefore the decrease in home inflation becomes smaller when prices of the other countries rise. That is because the rise in the foreign countries' prices leads to a rise in the import price of the appreciating country, thereby there is an offsetting effect on domestic prices in the appreciating country. Then if this is the case, it may be reasonable to suggest that the changes in the exchange rate of the Libyan Dinar has a negligible effect on domestic prices. However in other studies such as that of Kwack (69, p. 28) concerning the same topic, the above hypothesis is confirmed, as he indicated that "the feedback effect of a currency appreciation tends to offset the initial negative effect on the inflation of the appreciating country."

With respect to the demand vector, it is preferable to consider the huge development plan which started in 1971, which may produce a big rightward shift in the aggregate demand curve for tradable goods. Thus a dummy variable (DV) is needed to capture that shift, and it is equal to one for years after 1970 and zero otherwise. So the above equation may be specified as follows:

$$P_t = P\ (Ph,\ PMC,\ DS{\bullet}PMC,\ E,\ DE{\bullet}E,\ MX,\ DV,\ P_{t-1}) \qquad (9)$$

and signs of the partial derivatives are: P1, P2, P4, P5, P6, P7, P8 > 0 and P3 < 0 where MX is an index number of money supply (1964 = 1.00).

With respect to the price level of housing (as a nontradable good) it may be expected that its function may be influenced by the cost-push inflation, especially since wages in the housing production sector are very sensitive to the rising demand for housing and hence for workers even in the short run. Therefore the nominal wage is considered as proxy for the cost-push inflation. The other main factor influencing the housing price level is the imported inflation due to the fact that imports of building materials are a main factor in the housing production. Thus the price of imports of building materials in terms of foreign currency, and the exchange rate are to be included in the housing price function. The exchange rate is included as a separate variable in order to capture the effect of the Dinar appreciation on the housing price level. Here, the index number of money is also as a proxy for the demand vector representing demand pressures for housing in Libya. It is representing the demand pull inflation in the housing sector. But this variable is not appropriate for the second period without introducing a corrective variable. That is to say the introduction of a new social ideology tends to encourage people to hold their wealth in terms of more liquid assets, and during the last two years of the period the new measures discouraged people from holding houses as an asset. Thus a dummy variable (DR) for the revolution is needed to correct the slope of the demand vector with respect to the housing price level, and a negative sign is expected to this variable. That is because this variable may be interpreted also as representing a leftward shift in demand for housing, and hence it must have a deflationary effect on the housing price level. Finally it is important to consider the government measures in this sector, such as the big increase in the number of buildings and houses which were built by the government during the second period, and other factors affecting the supply of houses, namely reducing the old rents twice during a period of three years (1970-1973). The former factor tends to shift the supply curve of housing to the right, and hence reducing (Ph), while the latter factors tend to shift the supply curve to the left, and hence increasing (Ph). Thus a dummy variable (Dh)[5] is needed to capture the net effect of these measures working in the opposite directions with respect to the housing price level. Then a lagged dependent variable is added also in order to see whether the desired pricing of housing is adjusted during the same period or not. So the housing price level function may be specified as follows:

$$Ph_t = Ph\ (W,\ PB,\ E,\ MX,\ DR \bullet MX,\ Dh,\ Ph_{t-1}) \qquad (10)$$

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[5]Its value is one for years greater than 1969 and zero otherwise.

where the signs of coefficients are: Ph1, Ph2, Ph3, Ph4, Ph7 > 0 and Ph5 < 0 while Ph6 can be negative or positive.

Money Supply

The best known money supply models which have a reasonable theoretical analysis and plausable empirical results are the adjustment ratio theories. The most important work in this area is that presented by Friedman and Schwartz (41) and Cagan (16). The Friedman money supply identity can be derived as follows:

$$Mi = m \cdot H \qquad i = 1, 2 \tag{11}$$

where Mi is money and i denotes the definition of money; that is currency outside banks plus demand deposits of the non-banking public which is called (M1), and the Friedman's definition of money which includes also time and saving deposits in addition to (M1). This money broadly defined is called (M2). (m) is the money multiplier, and (H) is the monetary base (high powered money) which contains currency outside banks (cc) plus the Central Bank's liabilities to the private sector including commercial banks and economic government institutions, that is reserves (R) of commercial banks including their vault cash (V), plus deposits of the private sector including economic government institutions with the Central Bank (DC). Thus:

$$H = CC + R + DC \tag{12}$$

$$R = Rd + V \tag{13}$$

where Rd is the deposit reserves of commercial banks with the Central Bank. Then, since M1 = CC + DD, the multiplier is:

$$m1 = \frac{M1}{H} = \frac{CC + DD}{CC + R + DC}$$

Divide the numerator and denominator by (DD); this gives

$$m1 = \frac{M1}{H} = \frac{\left(\frac{CC}{DD} + 1\right)}{\left(\frac{CC}{DD} + \frac{R}{DD} + \frac{DC}{DD}\right)} \tag{14}$$

or

$$M1 = \frac{\left(\frac{CC}{DD} + 1\right)}{\left(\frac{CC}{DD} + \frac{R}{DD} + \frac{DC}{DD}\right)} \cdot H \tag{15}$$

For M2, the identity becomes:

$$M2 = \frac{\left(\frac{CC}{TD} + 1\right) \cdot H}{\frac{CC}{TD} + \frac{R}{TD} + \frac{DC}{TD}} \tag{16}$$

where TD = DD + TS.

That is to say, the money supply is influenced by three sectors: (1) the Central Bank has some control on the monetary base and some control over the volume of commercial bank reserves; (2) the commercial banks are hypothesized to have a desired relationship between reserves and deposits, and hence they may determine the reserve-deposit ratio;

(3) the non-banking public is hypothesized to have a desired relationship between currency and commercial banks deposits, and hence the public controls the currency-deposit ratio. They may control partly the ratio $(\frac{DC}{DD})$ (during the period 1962-1970) which denotes the public preference (including government institutions) to have deposits at the National Bank of Libya, since it was the only national bank available up to the end of 1963. Despite some foreign banks accepted to have a Libyan partner establishing a new Libyan bank in 1964, some people still preferred to deal with the commercial banking division (during the period 1964-1970) which is linked to the Central Bank of Libya. During that time this department was not subject to the legal reserve requirements, since it is under the control of the Central Bank. But since 22 December 1970, this commercial division is separated from the Central Bank to be fully a commercial bank and subject to reserve requirements. However, money deposits with the Central Bank did not disappear, because there were still some economic quasi-government institutions dealing with it.

The multiplier itself is influenced directly by any changes in the ratios of $(\frac{CC}{DD})$, $(\frac{R}{DD})$, and $(\frac{DC}{DD})$. Thus the most effect on the multiplier is coming from the public's behavior through $(\frac{CC}{DD})$ and $(\frac{DC}{DD})$ ratios and from the commercial banks behavior through $(\frac{R}{DD})$ ratio, while the central bank may have some influence on the $(\frac{R}{DD})$ and $(\frac{DC}{DD})$ ratios. Therefore, if the actual ratios differ from the desired ratios, the three economic sectors mentioned above adjust the actual ratios, and in turn these adjustments cause changes in the multiplier, and the latter causes the same changes in the money supply, since the money supply is a positive function of the multiplier.

In this study the $(\frac{DC}{DD})$ ratio is likely to be considered as an exogenous variable, because it is influenced mostly during the period 1962-1970, and wholly during the later period, by those economic government institutions who are imposed by government to deal with the commercial banking division of the Central Bank (or the Central Bank). But the other two ratios are endogenously determined.

The Currency-Deposit Ratio

Now concerning the public behavior in determining the currency-deposit ratio, it is assumed that this ratio is dominated by relative movements in demand for currency and demand for deposits, as Boughton and Wicker did (10, 409) since the supply functions of currency and deposits are not important in determining this ratio. So once individuals have decided through their demand functions for currency and deposits, how much real balances of these components of money, they are going to hold, they also have decided the proportion between cash and deposits in which they are going to hold their money balances. The currency-deposit ratio may be influenced by the following factors:

1. As income increases demand for money increases. But since the growing acceptance of checks is expected as a country develops, so the growth rate of deposits is expected to be faster than that of currency. Then as the government sector and the business sector become larger, the acceptability of checks has been widened. Thus it is expected that the demand for demand deposits to have a higher income elasticity than the demand for currency, which means an increase in income tends to increase the demand for demand deposits relative to currency and generate a decline in the currency-deposit ratio. Cagan

has also indicated that not only income growth reduces $(\frac{CC}{DD})$ ratio if the income elasticity of currency is less than that for DD, but also urbanization may reduce the relative use of currency, as a result of the spread of banking on one hand, and increasing familiarity with the advantages of checking accounts, hence the banking habit on the other. Urbanization works also in the other direction, that is, "the impersonal nature of urban trade discourages the use of checks and credit." Therefore Cagan (16, p. 128) argued that "these two supposed effects of urbanization on currency demand work in opposite direction and there is not a priori basis for expecting their net effect to work one way or the other".

2. Another factor affecting the $(\frac{CC}{DD})$ ratio is the relative cost of making exchanges with the two components. Neither earns any interest, therefore if there is implicit interest or benefit on demand deposits, this interest or benefit may be felt by the asset holder only. Holders of demand deposits may have an expected loss rate or benefit rate, by which they are discouraged or encouraged to hold an asset. That is an increase in the expected loss rate leads to diminish the attractiveness of deposits, and hence a shift may occur from deposits to currency, thereby increasing the currency-deposit ratio. An attempt was made by Cagan in calculating the expected loss rate based on the past experience and some average of past loss. But this approach is not adequate as is recognized by Cagan himself (15, p. 320). In the case of Libya no loss has been occurred during the period, but the inefficient services offered by banks may cause a high cost for holders of demand deposits. This cost may be explained as the income foregone during the time a check is cashed, which takes sometimes one hour or more.

However there is no way to measure such a cost except by collecting data from customers which are not yet available. However, the competitive rate of interest on demand deposits calculated by Klein (61, p. 936) is considered in this study as follows:

$$rd1 = rs\ (1 - \frac{R}{DCO});\ \text{where } DCO = DD - DC; \tag{17}$$

$$rd2 = rs\ (1 - \frac{R}{TDCO});\ \text{where } TDCO = DCO + TS; \tag{18}$$

where rs is the rate of interest paid on time and saving deposits. (rs) has been fixed at 4% as maximum since July 1963. Thus, Klein hypothesized that commercial banks do pay interest payments on demand deposits, despite it being announced that such interest is prohibited. This hypothesis is supported by the empirical study of Teixeira (102, p. 42) in the Brazilian economy. So the interest rate on demand deposits (rd1) shall be calculated according to the above equation and it is expected to be negatively related to the currency-deposit ratio. That is, an increase in the rate of interest on demand deposits leads to increase holding of these deposits, and the latter means a decrease in the currency-deposit ratio. However, if the expected loss rate incurred by the holders of demand deposits exceeds the implicit interest rate on demand deposits (benefit rate), a decrease in holding of demand deposits may occur, and the latter means an increase in the currency-deposit ratio.

3. It has been also argued that changes in the distribution of income may affect the currency-deposit ratio because different income groups have different preferences for money components. It is observed

that in less developed countries most wages and salaries are paid in cash. In addition the wage-earners are low income earners, consequently the level of their savings is negligible if there is any, therefore they do not tend to have checking accounts with commercial banks. Thus for these people, currency holding may be the only media for transaction purposes, and for other income groups currency holding may be the only means of holding wealth (hoarding). Therefore it is preferable to include a variable say the share of income paid as salaries and wages to represent the degree of income distribution to capture those effects in the currency-deposit ratio function. Other effects increasing holding of currency are also the changes in military wages and salaries which were found by McDonald (77, p. 326) to be important. But Cagan (15, p. 317) indicated that this factor is not important, "because new entrants to the armed forces also experience a substantial reduction in money income." This is true for developed countries, while it is not likely that Cagan's argument be considered in the case of less developed countries, especially if there is a high level of unemployment. An increase in the labor's share of income relative to that of other factors of production, leads to increase the holding of currency, hence the currency-deposit ratio.So the share of income (WY) going to labor and employees must be positively related to the currency-deposit ratio. But in the case of Libya, the positive sign may not be obtained for two reasons: (a) more than 50% of the GNP is contributed by the oil sector which is a capital-intensive industry, (b) the government forced its employees to open checking accounts with commercial banks in order to receive their salaries in these accounts, therefore the sign of (WY) variable may be negative, especially if all data are available at the end of months. However, a dummy variable shall be used to capture the government action in this respect, while with respect to the first reason, the GDP of the non-oil sector, rather than (Y) shall be tried also (WYP). The currency-deposit ratio function, therefore, can be specified as follows:

$$\left(\frac{CC}{DD}\right) = C\left(\left(\frac{Y}{P}\right), rd1, WY, \left(\frac{CC}{DD}\right)_{t-1}\right) \qquad (19)$$

where signs of the partial derivatives are: C1, C2 < 0 and C3, C4 > 0.

The Reserve-Deposit Ratio $\left(\frac{R}{DD}\right)$

This ratio is important for two reasons: (1) the Central Bank has some control on this ratio as it can change its legal reserve requirement rate which is an important instrument of monetary policy, especially in less developed countries; (2) it reflects the behavior of commercial banks in adjusting their desired reserve-deposit ratio, and with respect to the public, it reflects the confidence or lack of confidence in the monetary authority. This is why Cagan and Friedman and Schwartz explain changes in the reserve-deposit ratio in terms of confidence in the banking system and not in terms of the cost of holding reserves. Cagan (44, p. 27) discounted the cost of holding reserves as an important explanatory variable of cyclical changes in the reserve-deposit ratio. However it is preferable to have the opportunity cost that commercial banks incur by holding reserves, and it may be calculated as the interest foregone as they could substitute earning assets for these reserves, or using the same rate of interest paid on those deposits subject to reserve requirements. In this study the competitive rate of interest (rd2) which is calculated according to Klein's equation, is used in the reserve-deposit ratio function.

Another factor affecting the $(\frac{R}{DD})$ ratio is the ratio of demand deposits to total deposits including time and saving deposits $(\frac{DD}{TD})$, because there are different legal reserve requirement rates on these deposits; therefore an increase in demand deposits relatively more than that of time deposits tends to increase the reserve total deposit ratio $(\frac{R}{TD})$ since the required reserve ratio for time and saving deposits (TS) is lower than it is for demand deposits. But this relationship must be negative when the reserve-demand deposit $(\frac{R}{DD})$ ratio is concerned, as R contains reserves held against time deposits[6].

Assuming a constant rate of reserve requirement, as the case in Libya, the growth rate of reserves reflects the growth rate of total deposits. Therefore this rate of growth is highly correlated with

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[6] If the reserve requirement rate is α on time and savings deposits and β on demand deposits $(\beta > \alpha)$ then the amount of reserves is:

$$R = \alpha TS + \beta \bullet DD = \alpha(TD-DD) + B \bullet DD \;;$$

(a) $\therefore R = \alpha TD + (\beta-\alpha)DD$

(b) $(\frac{R}{DD}) = \alpha(\frac{TD}{DD}) + (\beta-\alpha) = \alpha(\frac{DD}{TD})^{-1} + (\beta-\alpha)$

(c) $(\frac{R}{TD}) = \alpha + (\beta-\alpha)(\frac{DD}{TD})$

Now taking the partial derivative of reserve deposit ratio with respect to $(\frac{DD}{TD})$ in equations (b) and (c), we get

from (b) $\frac{\partial(\frac{R}{DD})}{\partial(\frac{DD}{TD})} = -\alpha(\frac{DD}{TD})^{-2} < 0$

from (c) $\frac{\partial(\frac{R}{TD})}{\partial(\frac{DD}{TD})} = (\beta-\alpha) > 0$ since $\beta > \alpha$

both reserves and deposits, hence with their ratio. That is, the growth rate of reserves is positively related to the reserve-deposit ratio.

Then the growth rate of reserves (GR) may be used as to improve the goodness of fit and to explain the trend of the function. This variable is used by Teixeira (102, p. 44) in his study on the Brazilian economy. Thus the reserve-deposit ratio function may be specified as follows:

$$\left(\frac{R}{DD}\right) = R\left[LR,\ rd2,\ GR,\ \frac{DD}{TD},\ \left(\frac{R}{DD}\right)_{t-1}\right] \qquad (20)$$

where LR is the average of legal reserve requirements, and other variables are as indicated above. While the expected signs for the coefficients of independent variables are: R1, R3, R5 > 0, and R2, R4 < 0.

So in general the multiplier and hence the money supply is a negative function of the above two ratios[7] while money supply is a positive function of the monetary base which is under the control of the monetary authorities. But the monetary base in Libya is not wholly

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[7]Denote $(\frac{R}{DD})$ by A and $(\frac{CC}{DD})$ by B and $\frac{DC}{DD}$ by C, thus the multiplier is:

$$m = \frac{(B + 1)}{(B + A + C)} \quad \text{as } A, B, C < 1.$$

Now by taking the partial derivative of m with respect to A and B in turn, therefore:

$$\frac{\partial m}{\partial B} = \frac{(A + C) - 1}{(B + A + C)^2} < 0 \text{ if } A + C < 1$$

and they were less than one in the whole period.

$$\frac{\partial m}{\partial A} = \frac{-(B + 1)}{(B + A + C)^2} < 0$$

controlled by the Central Bank, since it is affected directly by the changes in net foreign assets of the Central Bank and the latter is also affected by the different transactions in the balance of payments which is under the control of other government agencies (other than the Central Bank). Thus the monetary base is also considered as an endogenous variable given by the following identity:

$$H_t = CP_t + CG_t + NFA_t - NL \qquad (21)$$

where CP denotes claims on the private sector, CG denotes claims on the government, and NFA denotes net foreign assets. NL is (other items net) which turns to be net liability of the Central Bank's balance sheet. Here it is likely to be noted that the (CG) and (NFA) variables include the small amounts which the commercial banks hold. Thus to sum up the main equations of the money supply mechanism are as follows:

$$Mi = mi\ H \qquad i = 1, 2. \qquad (11')$$

$$mi = \frac{\left(\frac{CC}{Di}\right) + 1}{\left(\frac{CC}{Di}\right) + \frac{R}{Di} + \frac{DC}{Di}} \qquad (14')$$

where D1 = DD and D2 = DD + TS = TD.

$$\left(\frac{CC}{Di}\right) = Ci\left[\left(\frac{Y}{P}\right),\ rdi,\ WY,\ \left(\frac{CC}{Di}\right)_{t-1}\right] \qquad (19')$$

$$rd1 = rs\left(1 - \frac{R}{DCO}\right), \quad \text{or} \quad rd2 = rs\left(1 - \frac{R}{TDCO}\right) \qquad (17,18)$$

$$\left(\frac{R}{Di}\right) = Ri\left[LR,\ rd2,\ GR,\ \frac{DD}{TD},\ \left(\frac{R}{Di}\right)_{t-1}\right] \tag{20'}$$

$$H_t = CP_t + CG_t + NFA_t - NL_t \tag{21}$$

The Supply of Output

Oil production is the major contributor to increasing income in Libya. Gross domestic product can be broken into (1) oil sector production (OY) and (2) non-oil sector production (YP). The production of crude oil is determined by the capacity of the foreign oil companies during the first period (1962-1969) and by both oil companies and government during the second period (1970-1977). The value of domestic product in this sector is influenced by the quantity of oil produced (QX), the effective price of oil exports in dollars (OPX) since payment of oil exports are in dollars, and the exchange rate of the dollar in terms of the Libyan Dinar (ES). Thus the supply of the value of oil output is as follows:

$$OY = O\ (QX,\ OPX,\ ES,\ DRLP) \tag{22}$$

where DRLP is the change in real credits given to the economy; that is, the government tends to encourage investment in the non-oil sector in order to decrease dependency on oil sector, the change in credit facilities given to the non-oil sector is growing faster than that given to those companies providing services to oil producer companies, and hence this leads to decrease utilized capacity of oil producer companies and increase the utilized capacity of the other sector. That is, the oil output function is a negative function of the credit facilities. The expected signs of the independent variables are 01, 02 > 0 and 03, 04 < 0. The desired output of oil is assumed to be adjusted within the same period, since oil campanies and government have a major influence on the (QX) and the (OPX).

Now then, concerning the production function in the non-oil sector, it may be reasonable to assume the following production function:

$$RYP = \left(\frac{YP}{P}\right) = A\ (RMKP)^{\alpha} \cdot L^{\beta} \tag{23}$$

where A is technological change which is considered to be exogenous, RMKP is the real imports of capital goods to the private or non-oil sector as proxy for capital[8]. L is the number of labor force, assuming there is no unemployment. α and β are the output elasticities with respect to (RMKP) and (L) respectively. These two factors of production are assumed to be sensitive to the conditions for profit maximization which require that the marginal product of labor equals the real wage and the marginal product of (RMKP) equals the ratio of the real import price of capital goods to the output prices $(\frac{PWK}{P})$. Then taking the partial derivatives of (RYP) with respect to (RMKP) and (L) in turn to get the marginal product of the two factors and put them equal to ratios mentioned above, thus:

$$\frac{\partial(RYP)}{\partial(RMKP)} = \frac{\alpha(RYP)}{(RMKP)} = \frac{PWK}{P} \tag{24}$$

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[8] Assuming a constant rate of growth in capital from domestic sources.

$$\frac{\partial(RYP)}{\partial L} = \frac{\beta(RYP)}{L} = \frac{W}{P} \qquad (25)$$

Therefore, the expansion path of the non-oil sector is obtained by dividing marginal product of labor on the marginal product of (RMKP) as follows:

$$\frac{\beta}{\alpha} \cdot \frac{(RMKP)}{(L)} = \frac{(\frac{W}{P})}{(\frac{PWK}{P})} \qquad (26)$$

While the total cost equation may be defined as follows:

$$TC = (W \cdot L) + (PWK \cdot RMKP) + FC \qquad (27)$$

Where FC is total cost of other capital stock and technological change which is determined exogenously. Then following Otani and Park (86, p. 171)[9] in deriving a supply function of desired output which is a function of real wage and import price of capital goods to domestic price ratio, a neoclassical supply function of desired real output is derived.

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[9]Solving (26) and (27) for L and (RMKP), and substitute the results in (23), so we get

$$(RYP) = A \left[\frac{(TC - FC)^2}{W(1 + \frac{\beta}{\alpha})} \right] \cdot \left[\frac{(TC - FC)}{W(1 + \frac{\alpha}{\beta})} \right]^{\beta}$$

Then we obtain the total cost function in terms of (RYP) and differentiate TC with respect to (RYP) to get marginal cost and set the latter equal to the price of output. Thus the supply of output has the following form(log(RYP) = f(log P, log W, log PWK) where F1 > 0 and f2, f3 < 0. The function is modified to contain real wages and the ratio of PWK to the domestic price level, aiming to avoid the problem of multicollinearity as indicated by Otani and Park.

Then the import price of capital goods (PWK) can be broken into (1) import price of capital goods in terms of foreign currency (PK) and (2) exchange rate in terms of the home currency (E). That is, to separate the effects of the exchange rate variable which is a monetary policy instrument.

$$(RYP) = Y\left(\frac{W}{P}, \frac{PK}{P}, E, DRLP, RYP1\right) \tag{28}$$

where DRLP is the change in real credit facilities granted to the public as a proxy for the capacity utilization, since there are many factories and other producer units do not utilize their full capacity because of the shortage in skillful labor. This proxy is chosen because the change in credit facilities can be safely taken as a proxy for the working capital of the producers units, by which they may increase the utilized capacity of these units. Therefore the output supply function is a positive function of the change in real credit facilities. Then as it is felt that there is unutilized capacity of some degree, it is reasonable also to assume that the desired real output may not be adjusted within the same period, so the actual output may lag behind the desired output, thereby a lag is introduced (RYP1). Then (Yi) being the partial derivative with respect to the ith argument, the parameters signs are: $Y1, Y2, Y3 < 0$ and $Y4, Y5 > 0$. Then the discussion is closed in this section by the following two identities:

$$GDP = (RYP)P + OY \tag{29}$$

$$GNP = GDP - FY + IT - S \tag{30}$$

Where GDP is gross domestic product of the whole country, GNP is gross national product, both in current prices, FY is income belonging to foreign factors of production, IT is indirect taxes, S is subsidies. FY, IT, and S are considered as exogenously determined.

The Balance of Payments (BOP)

Johnson (57, p. 17) indicated that "the usual approach to the (BOP) is to consider it as the difference between receipts from and payments to foreigners by the residents of the country excluding the monetary authority". Thus if there is a difference which is called (deficit or surplus), it is the responsibility of the monetary authorities. In Libya, until 1973 the amount of currency issued was wholly backed by gold and foreign exchange assets. While in 1973 government treasury bills were introduced to constitute not more than ten per cent of the total currency issued. Therefore the change in net foreign assets is reflected directly in the domestic money supply. If the monetary base is considered as exogenous variable, then our model is closed and there is no need for the monetary base identity (21) shown in the money supply mechanism. But the change in net foreign assets is considered as endogenous variable, since it is affected by factors other than that of the monetary authorities, such different kinds of commercial controls as tariffs, subsidies and quota. The effect of these commercial controls is to create a gap between the internal and the external prices of tradable commodities. That is, the restriction of imports makes the external price of goods less than the internal price. However, the monetary authority in Libya controls the exchange rate, so that when the dollar was devalued twice in 1971 and 1973, the Libyan Dinar was appreciated vis a vis the dollar, which may be considered as being the equivalent of an import subsidy leading to narrowing the gap between external and internal prices. In short the balance of payments identity is:

$$\Delta NFA = NX - NM - NK \tag{31}$$

where (ΔNFA) is change in net foreign assets, (NX) is net exports of goods and services in the oil sector and denotes here the surplus (positive), (NM) is net imports of goods and services in the non-oil sector which is a deficit in the current account of the balance of payments (negative), and (NK) is net capital outflow from non-oil sector, so it is negative in the equation. It is likely to note that errors and omissions are included in the net capital outflow. NX variable is considered exogenous since it denotes net earnings of foreign exchange which belongs to the government and dominated by it. NK is also considered exogenous since the monetary authority is applying exchange control on such transfers.

Then the net imports of goods and services can be broken down into three main groups:

$$NM = MKP + MC + NS \tag{32}$$

where (MKP) is imports of capital goods and intermediate goods by the non-oil sector, (MC) is imports of consumer goods and (NS) the net imports of services. Since most of the expenditures on services comes from government and government institutions on one hand, and from Libyans traveling abroad, on which there is exchange control[10], on the other, thereby it is reasonable to consider (NS) as an exogenous variable. While with respect to imports of capital goods and consumer goods are left free in some degree to the private sector, and hence these two variables are considered endogenously determined. Imports of capital goods are mostly free of restrictions especially those durable goods, while most of the consumer goods are subject to customs in different degrees, and some consumer goods are government monopoly. Thus a tariff rate is appropriate to be an independent variable in the imports of consumer goods function. Now then taking into account the profit maximization principles and the above modified production function of the non-oil sector, the following import function of producer goods is derived:

$$RMKP = \left(\frac{MKP}{P}\right) = K\left[\frac{YP}{P},\ \frac{W}{PK},\ E,\ DRM2,\ \left(\frac{MKP}{P}\right)_{t-1}\right] \qquad (33)$$

That is, real imports of capital goods to the non-oil sector is a function of real gross domestic product in the same sector, the ratio of nominal wage to the price of capital goods in foreign currency, the exchange rate in terms of home currency, the change in real money balances broadly defined, and the lagged dependent variable, as it may be believed, because of lower capacity of the available Libyan harbors, that the desired level of imports of capital goods may not be adjusted to the actual level within the same period. The change in real money

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[10]The exchange control determines a maximum annual amount of traveling allowance for pleasure, at L.D. 300 per person over 12 years old and L.D. 150 per child of 12 years old or less. A higher traveling allowance is permitted for businessmen. These quotas did not change since the sixties. However early in 1980, the traveling allowance was raised by 150 per cent.

balances is taken as a proxy for the assumed unutilized capacity in order to reflect its presence in reducing imports of capital goods. However the expected signs are: K1, K2, K5 > 0 and K3, K4 < 0. But here it should be noted that the slope of the exchange rate variable with respect to the dependent variable must be corrected during the second period which witnessed big changes and managed floating in the value of foreign currencies. Thus the dummy variable (DE) may be used in this respect, and it should also have a negative sign.

With respect to the demand for imports of consumer goods, assume that such a function is based on the consumer demand theory. Therefore the following form may be a satisfactory demand function for imports of consumer goods in the case of Libya:

$$RMC = \left(\frac{MC}{P}\right) = G\left[\frac{Y}{P}, \frac{PMC}{P}, E, Tr, \left(\frac{MC}{P}\right)_{t-1}\right] \qquad (34)$$

That is, the imports of real consumer goods (RMC) is a function of real gross national product (RY), the ratio of foreign price of imports in terms of foreign currency to the domestic price level, the foreign exchange rate in terms of home currency, the average tariff rate paid on imports of consumer goods, and the lagged dependent variable as it is widely believed, for the same purpose mentioned above, that the desired level of imports is not always equal to the actual level within the same period. This assumption is also based on the fact that the demand for consumer goods exceeds supply in many lines, so that there is a need for buyers to expand considerable efforts to buy goods at inflated prices. But with respect to the signs of the partial derivatives of the dependent variable with respect to the independent variables are as follows:

$$G1,\ G5 > 0 \quad \text{and} \quad G2,\ G3,\ G4 < 0$$

The dummy variable (DE) may also be used to correct the slope of the exchange rate with respect to the imports of consumer goods, as we did in the demand function for imports of capital goods.

Now to sum up, it is preferable to state the complete model and trace the working of the model in the Libyan economy.

The Complete Model

The structural equations (the coefficient's sign is above the variable):

$$(1)\quad RM1_t = \left(\frac{M1}{P}\right) = m[\overset{+}{RY},\ \overset{-}{RM},\ \overset{+}{RS},\ (RG\ \overset{-}{or}\ T),\ \overset{+}{RM1}_{t-1},\ \overset{+}{DR},\ \overset{-}{D76}]$$

$$(2)\quad P_t = P(\overset{+}{Ph},\ \overset{+}{PMC},\ \overset{-}{DS\bullet PMC},\ \overset{+}{E},\ \overset{+}{DE\bullet E},\ \overset{+}{MX},\ \overset{+}{DV},\ \overset{+}{P}_{t-1})$$

$$(3)\quad Ph_t = Ph(\overset{+}{W},\ \overset{+}{PB},\ \overset{+}{E},\ \overset{+}{MX},\ \overset{-}{DR\bullet MX},\ \overset{\pm}{Dh},\ \overset{+}{Ph}_{t-1})$$

$$(4)\quad \left(\frac{CC}{DD}\right)_t = C\ [\ \overset{-}{RY},\ \overset{-}{rd1},\ \overset{+}{WY},\ \overset{+}{\left(\frac{CC}{DD}\right)}_{t-1}\ ]$$

$$(5)\quad \left(\frac{R}{DD}\right)_t = R\ [\ \overset{+}{LR},\ \overset{-}{rd2},\ \overset{+}{GR},\ \overset{-}{\frac{DD}{TD}},\ \overset{+}{\left(\frac{R}{DD}\right)}_{t-1}\ ]$$

$$(6)\quad (OY)_t = O(\overset{+}{QX},\ \overset{+}{OPX},\ \overset{-}{ES},\ \overset{-}{DRLP})$$

$$(7)\quad (RYP)_t = Y\ [\ \overset{-}{\left(\frac{W}{P}\right)},\ \overset{-}{\left(\frac{PK}{P}\right)},\ \overset{-}{E},\ \overset{+}{DRLP},\ \overset{+}{RYP}_{t-1}\ ]$$

$$(8)\quad (RMKP)_t = K\,[\,\overset{+}{RYP},\ (\overset{+}{\frac{W}{PK}}),\ \bar{E},\ D\bar{R}M2,\ \overset{+}{RMKP}_{t-1}\,]$$

$$(9)\quad (RMC)_t = Y\,[\,\overset{+}{RY},\ (\frac{\overset{-}{PMC}}{P}),\ \bar{E},\ \bar{T}r,\ \overset{+}{RMC}_{t-1}\,]$$

The definitional equations:

$$(10)\quad RM = \frac{(Pt - P_{t-1})}{P_{t-1}}$$

$$(11)\quad RS = \frac{(Ph_t - Ph_{t-1})}{Ph_{t-1}}$$

$$(12)\quad MS1 = m1 \cdot H$$

$$(13)\quad m1 = \frac{(\frac{CC}{DD} + 1)}{(\frac{CC}{DD} + \frac{R}{DD} + \frac{DC}{DD})}$$

$$(14)\quad MX1 = \frac{MS1}{(MS1)_{1964}}$$

$$(15)\quad rd1 = rs\,(1 - \frac{R}{DCO})$$

$$(16)\quad H = CP + CG + NFA - NL$$

$$(17)\quad GDP = RYP \cdot P + OY$$

$$(18)\quad Y = GDP - FY + IT - S$$

(19) $RY = \frac{Y}{P}$

(20) $\Delta NFA = NX - NM - Nk$

(21) $NM = (RMKP + RMC)P + NS$

where variables are defined as follows:

CC*	Currency outside banks
CP*	Claims on private sectors (Central Bank)
CG*	Claims on government (Central Bank)
TD*	Total deposit liabilities of banks to the public
DCO*	Deposits of private sector at the commercial banks
DD*	Demand deposits of the public
$\frac{DC}{DD}$	The ratio of private deposits with the Central Bank (DC) to demand deposits
E*	Exchange rate index (1964 = 1.00) in terms of home currency
ES*	Exchange rate index of dollars in terms of home currency (1964 = 1.00)
GDP	Gross domestic product = OY + YP
GR*	The growth rate of reserves (R), but (AGR) denotes the average changes in (R)
FY*	Foreign factor's income
H	The monetary base (H = R + CC + DC)
IT*	Indirect taxes
LP*	Total credits to private sector (monthly average)
LR*	Legal reserve requirement ratio (monthly average)
M1	Money supply = DD + CC

M2	Money broadly defined (M2 = M1 + TS)
RM1	Demand for real balances $\frac{M1}{P}$
RM2	Demand for real balances $\frac{M2}{P}$
MX1	An index of money supply (M1) (1964 = 1.00)
m1	Money multiplier $\frac{M1}{H}$
MC	Imports of consumer goods
MKP	Imports of producer goods to the non-oil sector
NFA	Net foreign assets (central and commercial banks)
NK*	Net capital outflow in the non-oil sector (NOS)
NL*	Net liabilities of the Central Bank (other items net)
NM	Net imports of goods and services in (NOS)
NS*	Net services and non-oil exports in (NOS)
NX*	Net surplus of the oil sector in the balance of payments (net exports of goods and services plus net capital flow)
OPX*	Oil price index in terms of dollars (1964 = 1.00)
OY	Gross domestic product in the oil sector
P	The general price level, consumer price index, January 1964 = 1.00
PB*	Price index of imports of building material in terms of foreign currency (1964 = 1.00)
Ph	Price index of rents and prices of houses and building materials (Jan. 1964 = 1.00)
PK*	Price index of imports of producer goods in terms of foreign currency (1964 = 1.00)
PMC*	Price index of imports of consumer goods in terms of foreign currency (1964 = 1.00)
PWB	Price index of imports of building materials in terms of home currency (1964 = 1.00)
PWC	Price index of imports of consumer goods in terms of home currency (1964 = 1.00)

PWK	Price index of imports of producer goods in terms of home currency (1964 = 1.00)
QX*	Quantity of oil produced
R*	Reserves of commercial banks (deposits with the Central Bank plus their Vault cash)
rd1 (rd2)	The competitive rate of interest paid on DD (TD)
RG	Actual real development expenditures spent by the government
RM	The opportunity cost of holding money (the inflation rate)
rs	The rate of interest on time and savings deposits
Rs	The rental price of money substitute
RY	Real gross national product
S*	Subsidies paid by the government
Tr*	Average rate of tariff: total taxes on imports divided by imports of consumer goods
TS*	Time and savings deposits
W*	Average nominal wage = $(\frac{WS}{L})$
WS*	Wages and salaries (component of Y)
WY*	The ratio of (WS) to (Y) $\therefore WY = \frac{WS}{Y}$
WYP*	The ratio of (WS) to (YP) $\therefore WYP = \frac{WS}{YP}$
Y	Gross national product at current prices
YP	Gross domestic product in the non-oil sector

where * denotes exogenous variable. There are also six dummy variables defined as follows:

DR	Denotes uncertainty affecting demand for money, DR = 1 for years greater than 1969 and zero otherwise
D76	Denotes uncertainty affecting demand for money, D76 = 1 for 1976 and 1977 and zero otherwise
DV	Denotes big increase in development expenditures, DV = 1 for years greater than 1970 and zero otherwise

Dh Denotes government actions in the housing sector, Dh = DV

DE Denotes big changes in the exchange rate and the exchange rate floating DE = DV

DS Denotes subsidies to some consumer commodities, DS = DV

Thus the complete model contains 21 simultaneous equations with 21 unknowns and 33 exogenous variables excluding the lagged dependent variables. The endogenous variables are those shown on the left hand of the 21 equations. The exogenous variables excluding the lagged dependent variables are the following: RG, DR, D76, PMC, DS, E, DE, DV, PB, Dh, WY, LR, GR, $\frac{DD}{TD}$, QX, OPX, ES, DRLP, W, PK, DRM2, Tr, $\frac{DC}{DD}$, rs, CP, CG, NL, FY, IT, S, NX, NK, NS, $\frac{R}{DCO}$.

Now to trace the working of the model, it is likely to start by the major actual economic activity in the oil sector: suppose an increase in oil exports or oil prices, this will directly increase the amount of gross domestic product in the oil sector, which in turn gives rise at the same time to an increase in the amount of net earnings of foreign exchange (NX), hence the amount of foreign assets and the government deposits at the Central Bank of Libya. But since oil revenue is the major income of the government, such deposits will decrease as government spending is started, hence the monetary base will directly increase which will lead to an increase in the nominal money supply. As Libya depends mostly on imports, the pressure on prices of tradable goods will be lower in some degree than that on prices of nontradable goods (housing production). However both prices will increase, and the latter may stimulate more investment in the non-oil sector, so the output may also increase. The demand for imports of capital goods may also increase. As the real income increases it leads to an increase in both demand for real balances and demand for imports of consumer goods. Demand for real balances is also positively affected by the increase in the prices of housing and negatively affected by the increase in the general price level. But both increases in imports of capital goods and imports of consumer goods lead to decrease the amount of net foreign assets of the country, which in turn means a decrease in the monetary base and hence in money supply. However the increase in real income leads to a decrease in currency-deposit ratio which increases the money supply. In general the oil shock spreads to all endogenous variables in varying degrees (see Figure 1). The money market is in equilibrium when the demand for real balances equals the amount of real money supplied.

In this model the monetary authority has four policy variables, namely claims on government (CG), claims on private sector (CP), legal reserve requirements (LR) and the exchange rate (E). With respect to (CG) it is not wholly in the hands of the Central Bank, it can be administered by both the Central Bank and the government. However (CG) was negative during most of the period (net deposits) except during the last three years (1975-1977) where claims on government exceeds its deposits at the Central Bank.

Of interest is the fact that in an open economy the balance of payments plays an important role in determining changes in domestic money supply. Foreign reserves increase when residents desire to accumulate money balances faster than the rate at which monetary policy actions and other domestic factors increasing the stock of money supply. However this linkage between money market and the balance of payments is obvious from those equations of both sectors. If it is assumed that

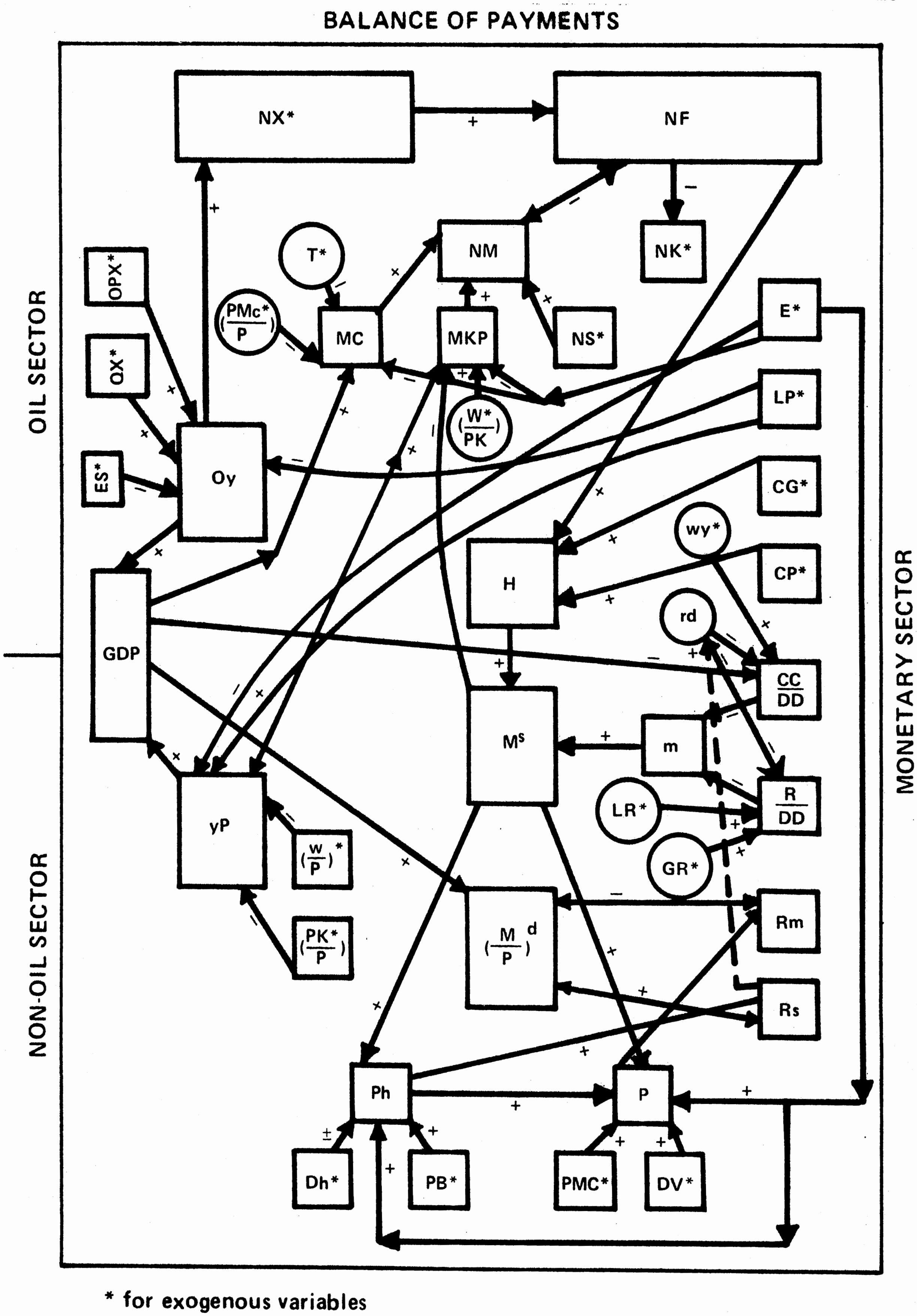

Figure 1. Flow Chart of the Complete Model Transmission Process in the Libyan Economy

the desired stock of money demanded is adjusted during the same period to the actual stock of money supplied, then, we may have the following system of equations:

$$M^d = P \cdot f(RY, RM, RS, e) \tag{35}$$

$$M^s = m \cdot H \tag{36}$$

$$M^d = M^s \tag{37}$$

$$H = NFA + (CP + CG - NL) = R + D \tag{38}$$

where R is foreign reserves and D is the sum of credit creation by the Central Bank. Consider also the assumption of fixed exchange rate, so such a variable is excluded from the system. Now putting the above system in terms of growth rates, therefore:

$$GM^d = GP + \alpha 1GRY - \alpha 2GRM + \alpha 3GRS + e' \tag{39}$$

$$GM^s = Gm + GH \tag{40}$$

$$GM^s = GM^d \tag{41}$$

$$GH = G(R + D) = \frac{R}{R+D} GR + \frac{D}{R+D} GD \tag{42}$$

$$\therefore GH = \frac{R}{H} GR + \frac{D}{H} GD \tag{43}$$

The coefficient ($\alpha 1$) is the income elasticity of demand for money, so it is expected to be positive, while ($\alpha 2$) is the opportunity cost elasticity with respect to demand for money and expected to be negative. $\alpha 3$ is the cross price elasticity of money and expected to be positive. The latter two elasticities must be within the range of such independent variables elasticities of demand for money.

CHAPTER V

DATA SOURCES AND ESTIMATION OF THE DEMAND FOR MONEY

Sources of Data and Derivation

Most of the monetary aggregates are taken from the *International Financial Statistics* of the International Monetary Fund (IMF). Items such as legal reserve requirements, time and savings deposits held by the public are taken from the *Economic Bulletin* of the Central Bank of Libya (C.B.L.). Such data are available monthly. Data of the balance of payments, such as net exports in the oil sector, net services, net capital outflow, and the changes in net foreign assets[1] are taken from both the *Economic Bulletin* and the Balance of Payments Book of the (IMF). Total imports, production of crude petroleum for the whole period, and the balance of payments of 1977 are obtained by a special request from the Economic Research Division of the Central Bank of Libya, and various issues of the *Economic Bulletin*.

The exchange rate as an index is calculated by the author for

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[1]As changes in net foreign assets (ΔNFA) which appears in the balance of payments (BOP) statistics differs from that appearing in the consolidated assets and liabilities of the banking system in Libya, it is preferable to consider those data appearing in the latter source as it is felt that this source is more adequate than the (BOP) data. Then to insure the equality of the two sides of the (BOP), the difference is included in the net capital outflow.

each foreign currency[2]. After weighting, by their contribution to Libyan imports, their indexes are used to derive the general exchange rate index. It is calculated quarterly and annually from monthly averages of absolute exchange rates of foreign currencies in terms of home currency. The imported-weighed index of exchange rate is:

$$Eh = \sum_{j}^{n} \left[\frac{Mjh}{(TM)} \right] Rjh \qquad j = 1, 2 \ldots 6; \quad n = 6$$

where TM is total imports and Mjh is imports of home country from country j. Rjh is the price of one unit of currency j in terms of home currency expressed as an index number relative to the base year and the

$$\sum_{j}^{n} \left[\frac{Mjh}{TM} \right] = 1.$$

Data for imports of producer goods (MK)[3] were calculated annually for the period (1968-1977) by the author from different issues of the Year Book of International Trade Statistics (United Nations) (ITS, UN), while the data of the period (1962-1967) were taken from various issues of the Annual Reports of the (C.B.L.).

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[2]The exchange rates of six foreign currencies in terms of Libyan Dinar (LD) are announced by the (C.B.L.) every working morning based on foreign exchange rates in the international market vis a vis the key currency for the (LD).

[3]The producer goods can be broken down into (K1) producers non-durable goods, (K2) producers durable goods. K1 and K2 are calculated according to the (SITC) code numbers with respect to Libyan data:
K1 = 2 + (5 - 55) + (6 - 657 - 69);
K2 = (7 - 7191 - 7241 - 7242 - 7321).

But the imports of consumer goods (MC) are obtained by subtracting (MK) from (TM), that is MC = TM - MK. The breakdown of imports for 1977 is not available, so imports of capital goods (MK) during 1977 are calculated as the average share during the three previous years.

Imports of capital goods by oil companies (OM) are obtained from the balance of payments statistics and various issues of the Economic Bulletin. Thus imports of capital goods by the non-oil sector (MKP) are obtained by subtracting (OM) from (MK).

National accounts statistics, such as GNP, GDP, and their breakdowns are obtained from various issues of National accounts statistics issued by the Ministry of Planning and Development. Actual development expenditures data are also obtained from the Ministry of Planning and Development.

The value of total transactions (TR) is estimated according to Lieberman (74, p. 307) as total debits to demand deposits (TDD) plus currency outside banks (CC) multiplied by the demand deposits turnover (TDD/DD). That is debits to demand deposits (adjusted for currency transactions) are used to replace GNP as measure of transactions in order to investigate whether demand for money is a transaction demand or an asset demand model. Thus in mathematical form:

$$TR = TDD + CC \cdot \frac{TDD}{DD}$$

Data on domestic price level and the housing price index are taken from various issues of the Economic Bulletin. These data are originally collected and calculated by the Census and Statistics Department in the Ministry of Planning and Development. In fact these data represent a family study conducted only in the Tripoli City, but it is safe to consider such data as representing the whole country. The weights used from the family budget study to the price index are mostly devoted to prices of foodstuffs, beverages and tobacco (37.2 per cent), and to prices of housing (32.2 per cent), while of the other five items, three items have a weight ranging between (5-10 per cent), and two items have a weight less than 5.0 per cent. These data are available on a monthly basis, and the data used in this study are the monthly average whether for the quarter or for the year. The general domestic price level (P) is considered as the GNP deflator, and its growth is used as the opportunity cost of holding money.

Data of import duties (or custom revenues) (TX) are obtained from a study on The Development of Public Finance (24, p. 23) for the period (1962-1966) and from "Recent Economic Development in Libya of Years 1972, 1976, 1978" prepared by (IMF) (53), for the rest of the period. Most of these data are given as for the goverment financial year which started the first of April to the end of March. However the budget year was changed to coincide with the calendar year as from 1974. Thus these data given as for the budget years are transformed to be as for the calendar year by the following identity:

$$TX\ (1963) = \frac{TX\ (1962/1963)}{4} \times 1 + \frac{TX\ (1963/1964)}{4} \times 3$$

Then the average tariff rate (Tr) is obtained by dividing (TX) by the amount of imports of consumer goods. That is because most imports of producer goods are exempted from import duties as a government policy to encourage domestic production.

The oil price index (OPX) of crude exports is obtained from the

International Financial Statistics of the (IMF), Page for Libya. The base period of this index is 1975, but for homogeneity with other indexes used in this study, its base period is changed to 1964. This index represents the foreign price of crude oil in dollars. The import price index of consumer goods (PMC) is calculated as the average of: (a) average unit value index of food exports from developed economics which is obtained from the (ITS, UN), Year Book 1977; (b) average of manufactured unit value index of the main countries contributing to imports of Libya weighed by the countries share of imports. That is, PMC = (a + b)/2; while the import price of capital goods (PK) is obtained from various issues of Year Book of (ITS, U.N.). That is to say the price index of machinery exports of developed economies is considered as a proxy for the price index of imports of capital goods. In this study there is a need also for the price index of imports of building materials (PB), and the price index of manufactured goods calculated in (b) above is considered as a proxy for such index, because many items needed for building and construction are found under this category.

But it is likely to note that all these indexes mentioned above and which are borrowed from the foreign sector, are not evaluated in domestic currency, therefore, they must be multiplied by the exchange rate index of the Libyan Dinar to reach the price index of imports in domestic currency. However, for the purpose of showing the effect of the exchange rate as separate in order to evaluate this tool of monetary policy, those mentioned price indexes are left to reflect foreign prices of imports in foreign currencies.

Concerning the labor force, the ministry of planning and development issued four estimates for the years 1964, 1971, 1973 and 1975, so the other estimates are interpolated on the basis of changes in actual economic development expenditures. As it is believed that the shift in demand for labor is dominated by changes in economic development expenditures.

A major limitation from estimating the model by quarterly data is the fact that most of the varibles are available only in the annual basis. However, it is my belief that demand for real balances is very important in this study. This belief is based on the fact that demand for money has a strong relationship to the balance of payments on one hand, and that the supply of money is automatically issued according to the availability of foreign exchange assets on the other. Therefore, an interpolation is made for those variables needed for money demand function and not available quarterly such as the GNP and the actual development expenditures.

Interpolation of Quarterly Data

When a relationship between two variables is found to be strong and significant one can use a linear interpolation formula to interpolate for quarterly data of that variable whose annual data is available, and use its strong relationship to the other variable whose quarterly data is observable. So on the basis of such relationship it is reasonable to assume that the intrayear movements in these two variables are similar. Using a similar formula according to Madalla (76, 206) and assuming Y is the variable to be interpolated and X is the related variable which is observable quarterly, then:

$$TY = (Y_{t+4} - Yt)/4;$$

$$\hat{Y}_{t+1} = Y_t + TY;$$

$\hat{Y}_{t + 2} = Y_t + 2TY;$

$\hat{Y}_{t + 3} = Y_t + 3TY;$

$TX = (X_{t + 4} - X_t)/4;$

$\hat{X}_{t + 1} = X_t + TX;$

$\hat{X}_{t + 2} = X_t + 2TX;$

$\hat{X}_{t + 3} = XT + 3TX.$

Since the value of X is observable in each quarter, the errors committed in the linear interpolation of X becomes obvious $(Xi - \hat{X}i)$. Then using (TY/TX) as weight, the errors committed in the primary estimate of Y can be corrected by the following equation:

$$\overset{*}{Y}_i = \hat{Y}_i + TY/TX\ (X_i - \hat{X}_i) \qquad i = t + 1,\ t + 2,\ t + 3$$

That is by using the weight $(TY/TX = \Delta Y/\Delta X)$, it means also that variable Y will share the error committed in the primary estimate of X by the same strength in its relationship to variable X.

In this study gross national product (Y) is interpolated in the same manner. The income identity is $Y = C + I + G - (X - M)$, but since most of the consumption and investment goods come from imports and in the same time government expenditures and most parts of investments are financed from the earnings of oil exports which accounts for 99.9 per cent of the total Libyan exports, so it is reasonable to consider the sum of total merchandise imports and total oil exports (X) as a proxy for the sum of (C + I + G), consumption, investment and government expenditures. A correlation of 0.9966 is found between Y and X, which means a strong relationship between these two variables. Thus when the change in (Y) is regressed on the change in (X) it is found that:

$$\Delta Y = 70.279 + 0.940\ \Delta X;$$
$$(42.136)\quad (0.018)^{4}$$
$$\bar{R}^2 = 0.904;\quad D.W. = 1.776;\quad S.D. = 135.343$$

This regression is free of serial correlation based on the Durbin-Watson (d) statistic. Thus the change in (X) explains 90.4 per cent of those changes in (Y), and therefore Y can be interpolated safely since the related variable (X) is available and observable quarterly.

It is found also that the actual development expenditures (G) is related to the money supply (broadly defined) (M2), that is the correlation between (G) and (M2) is 0.992 and the first difference relationship is:

$$\Delta G = -4.661 + 0.845\ \Delta M2;$$
$$(26.890)\quad (0.174)$$
$$\bar{R}^2 = 0.619;\quad D.W. = 2.475;\quad S.D. = 75.171$$

The regression is free of serial correlation based on the (d) statistic. Therefore the changes in money supply, broadly defined, explains 62 per cent of those changes in government actual development expenditures, thereby the quarterly data of (G) can be interpolated as the related variable (M2) which is available and observable quarterly.

Testing Measures Used for Estimate Evaluation

Now since this chapter and the following chapter are devoted to estimate the coefficients in each equation. The model is estimated for the period 1962-1977 on quarterly basis with respect to money demand

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[4] Those numbers between parentheses below the coefficients are the standard error of that coefficient.

functions and on annual basis with respect to the whole model. This is due to the limitation that most of the variables are not available on a quarterly basis. However, estimating the money demand function with quarterly and annual data may show whether this limitation so one may spend more efforts to obtain the quarterly data even by interpolation. The SAS program[5] is used to estimate the model by the (OLS) technique. Each equation is estimated in linear and log-linear form.

With respect to testing the equation chosen to be included in the whole model, the following steps are considered:

1. The explanatory power of the regression is measured by the multiple correlation coefficient adjusted for degrees of freedom ($\bar{R}^2$) (65, p. 365).

2. The t-value shows whether the coefficient estimated is significant or not. As there is only sixteen observations to be used in this study, the estimated coefficient is statistically significant at the 5% level if the t-value exceeds 2.11, or 2.12 if there is a loss of one degree of freedom because of one period lag. However the standard errors, and not the t-values[6] are presented in parentheses below the estimated coefficients. This is convenient for those desiring to test others hypotheses.

The Durbin-Watson (DW) statistic is investigated whether

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[5]A User's Guide to SAS, 1976 was used, which is prepared by A. J. Barr, J. H. Goodnight, J. P. Sall, and J. T. Helwig.

[6]It is easy to calculate t-value as follows:

$$t = \frac{b}{Sb}$$

Where b is the estimated coefficient and Sb is its standard error.

there is serial correlation or not[7]. But this test was designed for one single equation model where there is no lagged dependent variable. Thus if the regression contained lagged dependent variables, Durbin (33, p. 419) developed alternative test which is called the Durbin h-test. If the higher degree of autocorrelation is desired, Godfrey (45, p. 1308) developed an interesting test for serial correlation in regressions with a lagged dependent variables. Concerning this study the Durbin h-test is satisfactory since the number of observations is small.

4. The ratio of absolute mean error to the mean of dependent variable (AME/$\bar{Y}$) is calculated to see how large is the error and hence how good is the equation for economic forecasting. The mean absolute percentage error (MAPE) is also used for the same purpose. The standard error is another measure for the equation to be preferred on another. However this measure is reported with each equation as (SD) in order to be recognized from standard error of the coefficient on one hand, and to follow the SAS program notation on the other.

Thus the above four steps are studied carefully for each equation, and the equation which gains a higher $\bar{R}^2$ and t-value and lower (AME/$\bar{Y}$), (MAPE) and (SD) is accepted in the complete model.

The model is estimated by the ordinary least squares (OLS) techniques as a first stage. But since the complete model is a simultaneous system of equations, so using (OLS) in estimating the parameters of this model yields estimates which are biased and inconsistent. Thus two stage

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[7]When there is no conclusive evidence of serial correlation a par is appeared above the ρ ($\bar{\rho}$). If the equation is corrected for such correlation, a star is appeared above the dependent variable, and the used (ρ1) is reported.

least squares (TSLS)[8] procedure must be used as it yields a superior result, that is the estimates of the parameters are biased but consistent (65, p. 562).

Last but not least it is unlikely to ignore the revolutionary change in the economic system of the country from a conventional one during the first period (1962-1969) to a growing socialistic economic system during the second period (1969-1977). Of interest is the fact that each period may have different estimates for each function of the whole model. In addition, each period may show the relevant independent variables for each function. Therefore a new information may be obtained from these periods analysis, showing the economic behavior development of the Libyan people during the whole period, and which may justify the extra double time of work spent and the doubled cost of computer services.

Demand for Money Estimation

Concerning money narrowly defined as demand deposits plus currency outside banks (Ml) and broadly defined as MI plus time and saving deposits (M2) then demand for money is estimated according to the following equation:

$$RMI = f\ [\ RTR \text{ or } (RY),\ RM,\ RS,\ RG,\ RMII,\ DR,\ D76\ ]$$

Where RMI is demand for real money balances, RTR is the real transaction, RY is the real gross national product, RM is the opportunity cost of holding money, RS is the rental price of money substitutes (housing), RG is government real development expenditures, RMII is the

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[8] (TSP) program is used for estimating the model by the (2SLS) procedure, as it has a simple procedure for correcting serial correlation.

lagged dependent variable or real money balances in the previous period, DR is a dummy variable indicating uncertainty arising from the banking system during the second period, and D76 is also a dummy variable indicating uncertainty arising from the nationalizing some buildings late in 1975.

With respect to RMI an experiment is done for investigating the relevant proxy for income. It is found when RTR is used most of the other independent variables become insignificant. While when (RY) is used as independent variable most of the other independent variables becomes significant at 5 per cent level except RG at 15 per cent level. Their standard errors become lower. R^2 is improved and the standard deviation (SD) of the regression is reduced. Thus within the linear format of demand for RM1 the empirical evidence in Libya has tended to favor the asset demand for money which is supported by Friedmand and Meltzer.

Thus the results of estimates are:

$$
\begin{aligned}
RM1 = &-20.329 + 0.170\ RY - 171.376\ RM \\
&\ (6.675) \quad (0.021) \qquad (50.885) \\
&+ 66.553\ RS - 0.114\ RG + 0.484\ RM11 \\
&\ (16.570) \qquad (0.071) \qquad (0.061) \\
&+ 28.157\ DR + 45.393\ D76; \\
&\ (7.744) \qquad (10.436)
\end{aligned}
\tag{1}
$$

$$\bar{R}^2 = 0.999; \quad h = -1.271; \quad SD = 6.916$$

All independent variables have the correct signs, and the regression is free of serial correlation according to the (Durbin) h test (since the equation has a lagged dependent variable) (33, p. 419) where

$$h = \hat{\rho}1 \sqrt{\frac{\eta}{1-n \text{ var } (\hat{B})}}$$

where var $(\hat{B})$ is the variance of the coefficient of the lagged dependent variable.

All independent variables are highly significant at the 5 per cent level except the proxy for technological change variable (RG). Now concerning (RM2) an experiment is done to include real value of transactions, instead of real income, but none of the variables are significant at all.

It is found also that (RG) as a proxy for technological change is not significant, in addition that RS and DR have a low level of significance. Better results are obtained when time is used as a proxy for technological change as done by Lieberman (74, p. 325) who said "A time trend would measure the mean rate at which new cash management techniques reduce money balances". When time is included the results are as follows:

$$\underset{}{RM2} = \underset{(10.058)}{-6.031} + \underset{(0.019)}{0.210}\,RY - \underset{(70.169)}{155.618}\,RM + \underset{(22.489)}{68.450}\,RS \qquad (1.2)$$

$$- \underset{(2.601)}{5.394}\,T + \underset{(0.066)}{0.416}\,RM21 + \underset{(12.285)}{42.090}\,DR + \underset{(14.011)}{29.496}D76$$

$\bar{R}^2 = 0.998$; $h = -1.442$; $SD = 9.675$

Where RM2 is real money balances broadly defined, RM21 is the lagged dependent variable, and other variables are as defined above.

The regression is free of first order autocorrelation, based on the Durbin-h test. All coefficients of independent variables are significant at higher levels and have the correct signs. However the intercept coefficient is not significant.

Concerning the logarithmic form, a semi logarithmic form is used because the variables RM and RS have some negative values. The same thing was done by Klein (61, p. 939). The estimates of demand for RM1 in its semi log linear form are obtained as follows:

$$LRM1 = \underset{(0.384)}{-2.338} + \underset{(0.109)}{0.845}\ LRY - \underset{(0.283)}{0.862}\ RM + \underset{(0.085)}{0.211}\ RS \qquad (1.1)$$

$$-\underset{(0.0001)}{0.0004}\ RG + \underset{(0.084)}{0.377}\ LRM11 + \underset{(0.050)}{0.124}\ DR$$

$$\bar{R}^2 = 0.998; \quad h = 0.117; \quad SD = 0.039$$

Where L is a prefix to the variable to denote that the amount of the variable is in log-value, that is LRM1 is the log of RM1.

First of all it should be noted that D76 is not significant, the reason it is omitted from the equation when semi log linear form is used. All other independent variables are highly significant. This equation is also free of serial correlation according to Durbin h test. Here it should be noted also that when the log value of real government expenditure on economic development is used instead of the absolute value its coefficient is neither significant nor of the correct sign.

The experiments on demand for RM2 are done to different regressions and the best results are obtained in the following regression:

$$LRM2 = \underset{(0.228)}{-1.568} + \underset{(0.090)}{0.802}\ LRY - \underset{(0.256)}{0.831}\ RM + \underset{(0.075)}{0.240}\ RS \qquad (1.21)$$

$$+ \underset{(0.082)}{0.279}\ LRM21 + \underset{(0.043)}{0.171}\ DR$$

$\bar{R}^2 = 0.999$; $h = -1.614$; $SD = 0.035$

This regression is free of serial correlation. The technological change variable is omitted, since it is found insignificant and with a wrong sign. While the other remaining variables are significant at a higher level.

Demand for Money (Disaggregated Model)

Disaggregated model of demand for money is defined as demand for real currency (RCC), real demand deposits (RDD), and real saving and time deposits (RTS), using the same independent variables of the aggregated model.

Now it is likely to investigate the disaggregated model of demand for money in order to see if there is any more information (can be reported) which the aggregated model of money demand does not obviously show.

Some experiments were made to obtain the best fit, of demand functions of currency (RCC), demand deposits (RDD) and time and savings deposits (RTS). The following regressions are the most plausible ones that we have found:

$$RCC = \underset{(6.855)}{-20.183} + \underset{(0.003)}{0.022}\ RTR1^{9} + \underset{(14.226)}{36.374}\ RS \qquad (d1)$$

$$+ \underset{(1.470)}{4.736}\ T + \underset{(8.246)}{14.144}\ DR + \underset{(9.598)}{21.073}\ D76$$

[9] One is added to the variable to indicate the lag of one period.

$\bar{R}^2 = 0.993$; D.W. $= 1.689$; $\bar{\rho} = 0.134$; SD $= 6.444$

$$LRCC = -1.317 + 0.289\ LRTR + 0.223\ RS \quad (d1.1)$$
$$(0.659)\quad (0.113)\qquad (0.107)$$
$$-0.0004\ RG + 0.835\ LRCC1^{9}$$
$$(0.0003)\qquad (0.061)$$

$\bar{R}^2 = 0.996$; $h = -0.610$; SD $= 0.054$

$$RDD = -18.278 + 0.121\ RY - 183.686\ RM + 63.133\ RS \quad (d2)$$
$$(4.920)\quad (0.011)\qquad (50.507)\qquad (16.771)$$
$$+\ 0.182\ RDDI^{9} + 34.009\ DR + 31.766\ D76$$
$$(0.073)\qquad (7.535)\qquad (9.838)$$

$\bar{R}^2 = 0.997$; $h = -0.925$; SD $= 7.068$

$$LRDD = -4.865 + 1.397\ LRY - 1.477\ RM \quad (d2.1)$$
$$(0.492)\quad (0.083)\qquad (0.479)$$
$$+\ 0.479\ RS - 0.0006\ RG + 0.400\ DR$$
$$(0.145)\qquad (0.0003)\qquad (0.068)$$

$\bar{R}^2 = 0.996$; D.W. $= 2.313$; $\bar{\rho} = -0.238$; SD $= 0.068$

$$RTS = 6.206 + 0.073\ RY - 4.054\ T \quad (d3)$$
$$(3.090)\quad (0.006)\qquad (0.791)$$
$$-24.794\ D76$$
$$(5.372)$$

$\bar{R}^2 = 0.979$; D.W. $= 2.312$; $\bar{\rho} = -0.162$; SD $= 4.343$

$$LRTS = -1.332 + 0.404\ LRY + 0.617\ LRTS1^{9} \qquad (d3.1)$$
$$\quad (0.828)\quad (0.211) \qquad (0.214)$$
$$\bar{R}^2 = 0.914;\quad h = 1.506;\quad SD = 0.222$$

It is found that the regression of demand for real currency is more plausible when the real value of total transactions is used as an argument, while when real income is used all other independent variables become insignificant. This means that the currency demand function in Lybia is a transaction demand model which is presented in Baumol (7) and Tobin (103). This is obviously shown in both forms linear and semi-log linear equations.

It is interesting to note that the lagged amount of real transactions (RTR1) shows a higher level of significance than that of the current value. The time trend has a wrong sign in equation d1. While the current value of real transaction is used in the semi-log linear form most independent variables show a reasonable level of significance. It is found also that the opportunity cost of holding currency (RM) is insignificant at very high level in both estimated forms. This is the reason why it is omitted from the currency demand function. This omission is reasonable since those who are holding currency either for the purpose of transactions as those of household and small business firms, or for precautionary purposes in the form of hoardings as those savers who are not familiar with the banking habit on one hand or because of the lack of confidence in banks on the other.

With respect to the demand function for real demand deposits, it is found that real income is more appropriate a variable than that of real value of total transactions. This result is expected since the transactions between people and business firms are not settled by checks. In addition, even the government institutions such as Electric Power Corporation and revenue department do not accept checks from persons or firms except if such checks are guaranteed by banks on which they are drawn. Thus most of such demand deposits are held by a limited number of medium and large commercial industrial and real estate firms of both a government and private sectors, mainly for transacting business among themselves and for covering letters of credits issued by banks for imports. So it seems that the demand function for real demand deposits is dominating the demand function for RM1, (the aggregate model) with respect to its sensitivity to changes in real income rather than in real transactions. This is why the demand function for RM1 is an asset demand model which was reported above, despite the fact that demand function for currency is a transactions demand model. This is one piece of information being gained from analyzing a disaggregated model.

The dummy variables DR and D76, if they are representing uncertainty in the case of individual persons and private business sector, are representing also the great expansion of government sector in economic activities during the 1970's and the shift of business from the private sector to the government sector. Thus the positive signs for the coefficients of DR and D76 are correct in both demand functions for currency and demand deposits. However if the private sector demand function for real demand deposits can be separated, then DR continues to have a positive sign reflecting the expansion of the private sector, while D76 should have a negative sign reflecting the contraction of the private sector economic activities. Here it seems that the semi-log linear regression does explain this situation more accurately, as the variable D76 is insignificant and irrelevant when it is added to regression (d2.1), so it is omitted.

Now concerning the demand function for time and saving deposits, it is found that the opportunity cost of holding such assets is not significant and has the wrong sign. However the fixed rate of 4% given by commercial banks covers at least about 78 per cent of the average inflation rate (5.13 per cent) during the period 1962-1977. However the positive sign for (RM) may be interpreted as the high rate of inflation which leads holders to shift a part of their demand deposits to time deposits in order to reduce the harm of inflation. This is true because most of such time deposits belongs to those medium and big firms and institutions participating in economic development activities, especially those of government.

Individuals may prefer to hold savings since it earns the same rate of interest, and this interest is exempt from income tax. The dummy variable D76 representing uncertainty with respect to holding of such deposits, which is developed during 1976 and 1977, is significant and relevant in the linear form (d3), while it is at lower levels of significance in the log-linear form, the reason it is omitted. However it has the correct negative sign, that is such uncertainty leads to reduce these deposits. The linear demand function for real time and saving deposits (d3) is plausible if compared with that of the log-linear form (d3.1).

The time trend in equation (d3) is highly significant and has a negative sign. But this negative sign should not be taken as the appropriate sign of the technological change proxy. It is my belief that this sign should be positive as the technological change leads to reduce the cost of managing cash and the cost of the banking activities in general, and hence the latter will induce bankers to increase the rate of interest or other facilities to attract more time and saving deposits. But in the Libyan case this negative sign of time trend in equation (d3) denotes (a) the increase in investment opportunities, which leads to shift funds from time deposits to investments in different fields on one hand and (b) the increase in credit facilities to individuals for building houses, which also leads to decrease the level of savings.

Now to sum up, more analytical information is given when the demand function for money is disaggregated. But the estimated regressions of this disaggregated model show a higher mean absolute error to the mean dependent variable which is calculated as:

$$(MAE/\bar{Y}) = \frac{1}{n} \sum_{i=1}^{n} (Y_i - \hat{Y}_i) \quad /\bar{Y}$$

According to Klein (64, p. 40) who used the absolute mean percentage error (AMPE), such percentage is still very high in the disaggregated model. This percentage is calculated as follows:

$$MAPE = \frac{1}{n} \sum_{i=1}^{n} \frac{(Yi - \hat{Y}i)}{Yi} \cdot 100$$

However both measures are accurate, but the first measure is easier as it needs less calculations. In addition the second measure may be affected, in case of a small number of observations like ours, by the first observation if it starts at a very low amount such as in the case equation (d2) as its (MAPE) decreased from 10.6 per cent to 5.3 per cent when the error of the first observation is ignored.

Table VII summarizes the different types of errors in order to evaluate the comparison between the aggregated and disaggregated money demand models. As shown in the table the more the model is disaggregated the more percentage of error will be. This is true also if the standard deviation of the regression is considered as a measure for selecting the plausible model. The lowest (MAE/$\bar{Y}$) is in demand function for RM1, as it amounts to 1.66 per cent, while that of (RM2) amounts to 1.71 per cent. But if (MAPE) is considered (RM1) has a higher percentage error 4.0 per cent compared to 2.4 per cent of RM2. This higher error comes mostly from the error of the first observation which if it is ignored the (MAPE) will equal 2.7 per cent, or close to that of (RM2). This is why it is preferable to depend safely on the first measure, that is the rate of the mean absolute error to the absolute dependent variable mean. However both demand functions for RM1 and RM2 are plausible, and either one used for the complete model, will give more plausible results with less expected errors if it is compared with disaggregated model of demand function for money. However those two selected equations (1 and 2) are free of serial correlations according to Durbin h-test, despite that this test is valid when the sample is large, that is D-h, $n > 30$, and that of D.W. test when there is no lagged dependent variable valid when the sample is greater than fifteen observations. In the case of developing countries where the number of observations is small, it was suggested that if the sign of residuals is changed in the regression four times or more, then this regression can be considered as free of autocorrelation (34, p. 23). So if this criteria is also considered, our two regressions mentioned above

TABLE VII

A COMPARISON BETWEEN AGGREGATED AND DISAGGREGATED MONEY DEMAND FUNCTIONS USING DIFFERENT MEASURES OF ERROR (ANNUAL DATA 1962-1977)

M. Demand Function	SD	MAE	MAE/$\bar{Y}$ %	MAPE %	RMSE	RMSE/$\bar{Y}$ %
1 - RMI	6.916	4.005	1.66	4.00	4.724	1.96
2 - RCC	6.444	4.434	4.56	8.38	4.991	5.13
3 - RDD	7.068	4.475	3.10	10.60	5.162	3.58
4 - RTS	4.343	3.110	8.79	13.36	3.884	10.97
5 - RM2	9.675	4.758	1.71	2.40	6.610	2.37
6 - LRCC	0.054	0.033	0.76	0.96	0.044	1.03
7 - LRDD	0.069	0.040	0.89	0.98	0.053	1.18
8 - LRMI	0.039	0.012	0.24	0.48	0.029	0.56
9 - LRTS	0.224	0.086	2.57	5.46	0.199	5.98
10 - LRM2	0.035	0.021	0.39	0.41	0.027	0.51

SD = standard deviation
MAE = mean absolute error
$\bar{Y}$ = dependent variable mean
MAPE = mean absolute percentage error
RMSE = root mean square error

are free of serial correlation. But since we get a high value of R^2 for both equations (0.999), despite that t-value is not very high even if it is significant at high levels, the reason that leads to the belief that some degree of multicollinearity is present in these two regressions.

However according to Klein's (64, p. 208) suggestion that multicollinearity is harmful only when the sample correlation between two independent variables is equal or greater than the multiple correlation of the regression ($r^2 \geq R^2$). If this is acceptable, then multicollinearity in our equations is not severe or harmful since the highest r^2 is 0.989 in regression (RM1) between RY and RG, and 0.975 in regression (RM2) between RY and RM21, which is lower than R^2 in both regressions.

But Kmenta (65, p. 389) indicated that (r^2) can be used as a measure of multicollinearity in the case of models with two explanatory variables, and when explanatory variables exceeds two, "the measurement of the degree of multicollinearity becomes more complicated."

A glance at Table VII shows that the choice of the best equation of demand for money becomes very easy as all those equations of the aggregated model have a lower percentage error than 5 per cent which is considered plausible (8, p. 185). However those equations estimated in semi-log linear form show a percentage of less than one percent; it is 0.24 per cent and 0.39 per cent for LRM1 and LRM2 respectively. But whether we choose the demand function in its linear form or semi-log linear form may depend on forms of other equations in the whole model.

Demand for Money (Quarterly Data)

All regression tests which were run with annual data, were estimated using quarterly data during the period 1962-1977. The results of the demand function for real money balances narrowly defined (RM1) are:

$$\underset{(4.413)}{RM1 = 1.297} + \underset{(0.012)}{0.041\ RY} - \underset{(74.474)}{140.329\ RM} + \underset{(33.437)}{57.952\ RS} \quad (1,Q)$$

$$+ 0.150\ RG + 0.630\ RM11 + 20.279\ DR = 27.107\ D76$$

$$(0.058) \quad (0.067) \quad (7.109) \quad (9.242)$$

$$\bar{R}^2 = 0.994; \quad D.W. = 2.260; \quad h = -1.230; \quad SD = 14.577$$

This equation shows that the intercept coefficient is statistically insignificant, while other coefficients of independent variables are significant except those of RM and RS which are significant at only 10 per cent level. The technological change proxy is significant but it has a wrong sign, which is an opposite result if it is compared with that regression using annual data, as this proxy is significant at lower levels (15 per cent) and has the correct expected sign. However if the regression is estimated without the intercept, the significance of all other coefficients are increased, R^2 is increased, SD is reduced, but the coefficients of RM and RS are still not significant at 5 per cent level.

The results of demand function for money broadly defined (RM2) are the following:

$$RM2^* = -7.217 + 0.069\ RY - 247.057\ RM + 91.101\ RS \qquad (2,Q)$$

$$(2.907) \quad (0.009) \quad (70.103) \quad (30.788)$$

$$+ 0.781\ RM21 + 6.993\ DR + 10.093\ D76$$

$$(0.036) \quad (4.785) \quad (6.680)$$

$$\bar{R}^2 = 0.995; \quad \rho = -0.417; \quad h = -2.923; \quad SD = 14.662$$

This equation is corrected for serial correlation whose existence is based on the Durbin h test. The technological change proxy is omitted since it is insignificant. In addition, DR and D76 are only significant at a lower level, while the rest of the independent variables are statistically significant at a reasonable level. The same regression using annual data is superior to regression (2,Q) as it shows a high level of significance including the technological change proxy (time trend).

But if these demand functions are estimated in the semi-log linear form, then the results are as follows:

$$LRM1^{*} = \underset{(0.105)}{-0.407} + \underset{(0.039)}{0.183}\ LRY - \underset{(0.229)}{1.285}\ RM \qquad (1.1,Q)$$

$$+ \underset{(0.100)}{0.284}\ RS + \underset{(0.035)}{0.845}\ LRM11 + \underset{(0.020)}{0.036}\ DR$$

$$\bar{R}^2 = 0.997; \quad \rho = -0.489; \quad h = -3.949; \quad SD = 0.049$$

$$LRM2^{*} = \underset{(0.253)}{-0.183} + \underset{(0.041)}{0.201}\ LRY - \underset{(0.220)}{1.274}\ RM + \underset{(0.096)}{0.356}\ RS \qquad (2.1,Q)$$

$$+ \underset{(0.013)}{0.012}\ T + \underset{(0.061)}{0.762}\ LRM21 + \underset{(0.019)}{0.042}\ DR$$

$$\bar{R}^2 = 0.998; \quad \rho = -0.445; \quad h = -3.586; \quad SD = 0.046$$

The variable DR in equation (1.1,Q) is not significant at a reasonable level and D76 is omitted as it is found statistically insignificant at all in both equations. The intercept is also insignificant in equation (2.1,Q). Neither equation was free of serial correlation, so each was corrected by non-linear least squares and the results are shown above. However the corresponding regressions which are estimated using the annual data are preferable since all their independent variables are highly significant. This is also the case if the comparison is applied on the disaggregated model which is shown and summarized in Table VIII.

Here it should be noted that the Godfrey (45) test for higher order

TABLE VIII

MONEY DEMAND FUNCTIONS DURING THE WHOLE PERIOD 1962.1-1977.4 (QUARTERLY DATA)

1) $$\underset{}{RCC} = \underset{(0.891)}{0.580} + \underset{(0.003)}{0.006}\ RY - \underset{(17.805)}{56.325}\ RM + \underset{(7.990)}{11.616}\ RS + \underset{(0.033)}{0.969}\ RCC1 + \underset{(2.174)}{4.386}\ D76$$

$\bar{R}^2 = 0.997$; $\rho = -0.079$; $h = -0.650$; $SD = 3.563$

2) $$RDD = \underset{(4.008)}{-5.773} + \underset{(0.011)}{0.036}\ RY - \underset{(71.410)}{111.912}\ RM + \underset{(31.871)}{44.297}\ RS + \underset{(0.056)}{0.156}\ RG + \underset{(0.086)}{0.506}\ RDD1 + \underset{(5.967)}{13.463}\ DR$$

$\bar{R}^2 = 0.986$; $\rho = -0.072$; $h = -0.781$; $SD = 14.078$

3) $$RTS^* = \underset{(1.345)}{-2.300} + \underset{(0.003)}{0.016}\ RY - \underset{(1.988)}{2.679}\ DR + \underset{(0.064)}{0.714}\ RTS1 - \underset{(2.737)}{5.029}\ D76$$

$\bar{R}^2 = 0.988$; $\rho = 0.431$; $h = 2.861$; $SD = 3.230$

4) $$LRCC = \underset{(0.062)}{-0.108} + \underset{(0.022)}{0.066}\ LRTR1 - \underset{(0.189)}{0.920}\ RM + \underset{(0.083)}{0.490}\ RS + \underset{(0.025)}{0.936}\ LRCC1 + \underset{(0.021)}{0.024}\ DR$$

$\bar{R}^2 = 0.998$; $\rho = -0.003$; $h = -0.024$; $SD = 0.037$

5) $$LRDD^* = \underset{(0.226)}{-0.725} + \underset{(0.064)}{0.233}\ LRY - \underset{(0.427)}{1.694}\ RM + \underset{(0.191)}{0.480}\ RS + \underset{(0.052)}{0.816}\ LRDD1 + \underset{(0.040)}{0.062}\ DR$$

$\bar{R}^2 = 0.994$; $\rho = -0.370$; $h = -2.962$; $SD = 0.088$

6) $$LRTS^* = \underset{(0.408)}{-1.019} + \underset{(0.111)}{0.319}\ LRY + \underset{(0.116)}{0.674}\ LRTS1$$

$\bar{R}^2 = 0.980$; $\rho = 0.552$; $h = 2.463$; $SD = 0.104$

TABLE VIII (Continued)

7) $RM1 = 1.297 + 0.041\ RY - 140.320\ RM + 57.952\ RS + 0.150\ RG - 0.630\ RM11 + 20.279\ DR + 27.107\ D76$

(4.412) (0.012) (74.474) (33.437) (0.058) (0.067) (7.109) (9.242)

$\bar{R}^2 = 0.994$; $\rho = -0.131$; $h = -1.230$; $SD = 14.577$

8) $RM2^{*} = -7.217 + 0.069\ RY - 247.057\ RM + 91.101\ RS + 0.781\ RM21 + 6.993\ DR + 10.093\ D76$

(2.907) (0.009) (70.103) (30.788) (0.036) (4.785) (6.680)

$\bar{R}^2 = 0.995$; $\rho = -0.417$; $h = -2.757$; $SD = 14.662$

9) $LRM1^{*} = -0.407 + 0.183\ LRY - 1.285\ RM + 0.284\ RS + 0.845\ LRM11 + 0.036\ DR$

(0.105) (0.039) (0.229) (0.100) (0.035) (0.020)

$\bar{R}^2 = 0.997$; $\rho = -0.489$; $h = -3.949$; $SD = 0.049$

10) $LRM2^{*} = -0.183 + 0.201\ LRY - 1.274\ RM + 0.356\ RS + 0.012\ T + 0.762\ LRM21 + 0.042\ DR$

(0.253) (0.041) (0.220) (0.096) (0.013) (0.061) (0.019)

$\bar{R}^2 = 0.998$; $\rho = -0.445$; $h = -3.586$; $SD = 0.046$

*Indicates that the regression is corrected for serial correlation, and those which have lagged dependent variables are corrected by the non-linear least squares method, and convergence criterion was met. The reported ρ in these non-linear equations are statistically very significant.

Note: See Appendix 1 for variables definitions.

serial correlation in those regressions including lagged dependent variables was investigated since the number of observations used in these regressions is appropriate for such a test[10]. It is found, however, when the Durbin h-test indicates that the errors are serially independent, the Godfrey test supports this result and continues to show no higher order of serial correlation. But when the Durbin h-test indicates the existence of serial correlation, the Godfrey test supports this result and continues to show a higher order of serial correlation, ranging between two to four. Of interest is the fact that when a higher order of serial correlation is indicated, the zero value is located between the first order and the second order of serial correlation, leading to the conclusion that this higher order of serial correlation may arise because of higher multicollinearity existing in these regressions. Thus it is logical to reject the high order of serial correlation in this respect, especially when the error is regressed on the lagged errors to the fourth lag period, only the first lagged error was found statistically significant.

Table IX shows a comparison (using different measures of errors) between the selected regressions (which are run on quarterly data) of aggregated and disaggregated demand functions for

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[10] The test procedure can be summarized as follows (45, 1308): (a) obtain (OLS) estimates of the regression, (b) use residual (u) as dependent variable to be regressed on lagged (u) to the wanted order and all other independent variables (c) R^2 in (b) multiplied by the number of observations (T), is asymptotically distributed as chi-square (X^2), that is $(T \cdot R^2)r = X^2 r$ where (r) is the order of serial correlation. Then significantly large values of $(T \cdot R^2)$ imply that the assumption that the errors are serially independent is not consistant with the sample data. So errors are serially independent when $(T \cdot R^2)r < X^2 r$.

TABLE IX

COMPARISON BETWEEN REGRESSIONS (QUARTERLY DATA) OF MONEY DEMAND FUNCTIONS USING DIFFERENT MEASURES OF ERROR

Demand for	MAE	MAE/$\bar{Y}$	MAPE	RMSE	RMSE/$\bar{Y}$	SD
RCC	2.322	0.0270	0.0341	3.389	0.039	3.563
RDD	9.029	0.0702	0.1129	13.273	0.1032	14.078
RM1	8.826	0.0412	0.0466	13.631	0.0636	14.458
RTS	2.725	0.0755	0.1142	3.300	0.0914	3.440
RM2	10.457	0.0424	0.0528	14.735	0.0588	15.629
LRCC	0.0282	0.0068	0.0073	0.0357	0.0096	0.0375
LRDD	0.0670	0.0155	0.0159	0.0881	0.0204	0.0926
LRM1	0.0393	0.0080	0.0079	0.0525	0.1064	0.0552
LRTS	0.0755	0.0229	0.0240	0.1077	0.0327	0.1104
LRM2	0.0367	0.0072	0.0072	0.0475	0.0093	0.0503

Note: These figures are calculated before the correction of serial correlations when such a correlation is present.

money. All different measures concerning errors support the view that the aggregated money demand functions are the appropriate ones by the conclusion of minimization of errors. Thus since these features produce a percentage error less than 5 per cent, as suggested by Klein (8, p. 185), such functions are eligible to be considered in the complete model. But if the ratio (MAE/$\bar{Y}$) is considered then all regressions (except RDD and RTS) are quite good, as this ratio is less than 5 per cent. However the semi-logarithmic form of money demand function is more accurate with respect to a lower level of error, and hence they may be more preferable to be included in the complete model, as the mean absolute percentage error is less than one per cent in each regression. However, the corresponding regressions estimated using the annual data are still preferable, as they indicate the least level of error.

Analysis by Period

As the period of this study witnessed two extreme types of philosophy with respect to economic thinking, it is useful to break the entire period into two sub periods. The first one is (1961-1969), the period that reflects the traditional government thinking which does not interfere in economic activities that the private sector is able to do, while the second period (1969-1977) reflects the revolutionary government's thinking, as the government role dominates in economic activities and the private sector accordingly shrinks especially during the last three years of this period. Another less important reason for breaking down the period of this study is that the economic development plans conducted during the second period are so big in amount of expenditures on one hand and in the expected goals to be achieved on the other so as to suggest a structural change. The annual average actual development expenditures in real terms is L.D. 207.6 million in the whole period (1962-1977), while the annual average during the first period was only L.D. 49.2 million compared to L.D. 329.4 million during the second period. In addition such expenditures are strongly correlated with the main variables included in the demand function for money. The correlation between real development expenditures (RG) and the other mentioned variables is different in these two periods as shown in Table X. Thus more investigation during each period may give information which would disappear when only the whole period is considered.

TABLE X

CORRELATION BETWEEN RG AND OTHER VARIABLES

Variable	P1 (61-69)	P2 (69-77)	1962-1977
RY	0.902	0.984	0.989
RM1	0.881	0.972	0.984
RM2	0.890	0.982	0.988
RM	0.086	0.519	0.100
RS	0.141	0.152	-0.056

Note: 1969 is included in both periods because most variables were influenced one way or the other by the First of September Revolution during the last four months of 1969.

First Period (1961-1969)

During this period the number of independent variables in the money demand function is reduced by two, namely the two dummy variables DR and D76, as these two variables were created in order to capture the effect of uncertainty felt by the public during the second period. Thus there are five independent variables including the lagged dependent variable. The demand functions for RM1 and RM2 are estimated by the (OLS) method and the following results are obtained; taking into account that the number between parentheses is the standard error of the coefficients' estimate shown upon this number.

$$\underset{}{RMI} = \underset{(3.576)}{-5.915} + \underset{(0.032)}{0.086}\ RY - \underset{(48.089)}{24.735}\ RM + \underset{(22.200)}{3.463}\ RS \qquad (1,P1)$$

$$\underset{(0.076)}{-0.032}\ RG + \underset{(0.165)}{0.761}\ RM11$$

$$\bar{R}^2 = 0.995; \quad h= -1.585; \quad SD = 2.818 \qquad (1.2,P1)$$

$$RM2 = \underset{(5.798)}{0.368} - \underset{(0.322)}{0.010}\ RY + \underset{(171.605)}{3.529}\ RM - \underset{(130.420)}{40.777}\ RS \qquad (1.2,P1)$$

$$+ \underset{(21.431)}{7.698}\ T + \underset{(0.476)}{0.716}\ RM21$$

$$\bar{R}^2 = 0.980; \quad h = \text{undefined}; \quad SD = 5.650$$

In regression (1, P1) only the coefficients of real GNP (RY) and the dependent lagged variable are significant, while the other variables despite they have the correct expected signs are insignificant. That is the demand for (RM1) is not sensitive to the rate of inflation (RM) in this period despite the average rate of inflation was at 6.1 per cent compared to the average of the whole period (5.5 per cent). Demand for RM1 is also not sensitive to the rate of change in prices of housing (RS) despite the annual average rate of the increase in such prices was 10.1 per cent which is higher than the rate of the whole period (7.9 per cent). It may be reasonable to explain this insensitivity as that most of the commercial banking business is owned by foreign banks which do not like to finance housing loans. The Real Estate Bank which was established by the government early in the 1960's, was not able to meet the big demand for its loans especially the rate of interest was 1.5% when it started and then abolished later. Real government expenditures which are a proxy for this change in technology, are also insignificant. If these insignificant variables are omitted then the demand function for RM1 becomes well specified as that RM1 is a function of real income and lagged dependent variable. These two independent variables become very significant at a high level as follows:

$$RM1 = -6.401 + 0.084\ RY + 0.730\ RM11 \qquad (1.1, P1)$$

$$(1.996) \quad (0.017) \qquad (0.104)$$

$$\bar{R}^2 = 0.997; \quad h = -1.451; \quad SD = 2.057$$

Equation (1.1, P1) is free of serial correlation according to both the Durbin h-test and the number of sign changes of residuals, as the sign changes six times. There is a high degree of multicollinearity in this regression, but it is not severe. According to Kmenta (65, p. 389) the correlation between RY and RM11 can be taken as a measure of multicollinearity which amounted to 0.970 compared to a higher multiple correlation (0.998) between the dependent variable and independent variables, on which it is based that the existing multicollinearity is not severe and harmful.

Now concerning the demand function for money broadly defined (RM2), equation (1.2,P1) it is also found that none of its variables is significant and with unexpected signs especially that of (RY) which should be positive. This negative sign of RY may be arised from including irrelevant variable for this first period, even if such variable is proved to be relevant for the whole period. However if those three independent variables with very low t-value are omitted such as RM, RS and T, then not only is a high level of significance gained to RY and RM21, but also the lowest level of standard deviation and the standard error of estimate is gained too. Thus the plausible regression, even if the coefficient of lagged dependent variable is significant at lower level, is as follows:

$$RM2^{*} = \underset{(1.832)}{-2.676} + \underset{(0.027)}{0.170}\ RY + \underset{(0.157)}{0.229}\ RM21 \qquad (1.21,P1)$$

$$\bar{R}^2 = 0.993; \quad \rho 1 = -0.817; \quad h = -2.376; \quad SD = 2.880$$

This regression is corrected for serial correlation whose existence is based on the Durbin h-test. However according to the rule of changing signs of residuals four times or more, it is free of serial correlation. Correction for serial correlation increased the absolute t-value of the intercept (from 0.42 to 1.46), decreased the t-value of the lagged dependent variable coefficient from 2.12 to 1.46 and increased the t-value of (RY) coefficient from 3.47 to 6.30. The degree of multicollinearity based on the correlation between RY and RM21 is 0.975, it is lower than the multiple correlation of the regression.

Thus the demand function for money in Libya, whether it is narrowly or broadly defined, has only two relevant independent variables, namely real gross national product and the lagged dependent variable during the period 1961-1969[11]. RM and RS become irrelevand variables because banking sector lending to the real estate business on one hand, was not substantial and on the other, people were not aware of inflation, as expectations and economic education among the business community in Libya were in their first stages of development. With respect to the proxy of technological change, it is clear why it was not relevant during this period, since the level of development expenditures was very low compared with the second period. Thus when the rate of technological change is very low, it is not a relevant variable for this period. Lieberman (74, p. 316) indicated that "the time trend variable may not have operated in the same fashion before World War II as it did after the war". However the period is very short and the development expenditures are normal during this period. So it is reasonable to expect that the technological change proxy to be a relevant variable, when the period is longer in the case of normal development expenditures or when the development expenditures are very high so that it leads to quick technological advances in the banking sector.

But when these two regressions are run with quarterly data, it is found that only two variables namely: RY and RG, are significant. Thus the regressions with quarterly data during the first period are:

$$RM1^{*} = 7.735 + 0.073\ RY + 0.490\ RG \qquad (1,P1,Q)$$
$$(5.221)\ (0.019)\qquad (0.101)$$

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[11] This is also the case when these money demand functions are estimated in their log-linear forms.

$\bar{R}^2 = 0.892$; D.W. = 1.259; $\rho 1 = 0.548$; SD = 4.638

$$RM2 = \underset{(3.512)}{12.766} + \underset{(0.017)}{0.116}\ RY + \underset{(0.087)}{0.325}\ RG \qquad (1.2,P1,Q)$$

$\bar{R}^2 = 0.968$; D.W. = 1.109; $\bar{\rho} = 0.345$; SD = 5.630

Equation (1.1,P1,Q) has shown evidence of serial correlation, so it is corrected for this serial correlation by the Cochrane-Orcutt method, and the results are shown in this equation. Equation (1.2,P1,Q) shows no conclusive evidence of serial correlation, however the star on the dependent variable denotes that the equation is corrected for serial correlation and bar on the ρ denotes no conclusive evidence of serial correlation.

Here it should be noted that RG is not a proxy for technological change as it is mostly spent on other fields of development such as education, health and agriculture development. These expenditures were mainly creating incomes and they are themselves as incomes to people, so that they are increasing the demand for money and especially the demand for currency. When it is assumed that the adjustment of demand for money is not complete within the quarter, the real income variable becomes insignificant. That is to say, t-value is (0.84) with respect to demand for RM1 and (0.99) with respect to demand for RM2. The coefficients of lagged dependent variables (RM11 and RM21) show a high level of significance, and their coefficients amounted to 0.987 and 0.929 respectively. They are not statistically different from one, so the coefficient of adjustment is zero, which means that demand for money in this period using quarterly data is being adjusted within the quarter. Thus the classical assumption is appropriate in this respect.

Second Period (1969-1977)

With respect to the second period, it is found that most independent variables of the money demand function (RM1) which were relevant in the whole period, are also relevant during this period. The results of those two regressions of demand function for money are as follows:

$$RM1 = -19.121 + 0.215\ RY - 344.354\ RM + 49.814\ RS^{12} \qquad (1,P2)$$
$$\quad (4.178)\quad (0.008)\qquad (23.571)\qquad (5.152)$$

$$- 0.244\ RG + 0.556\ RM11 + 18.177\ D76^{12}$$
$$(0.027)\qquad (0.017)\qquad (3.984)$$

$$\bar{R}^2 = 0.99990;\quad h = -0.660;\quad SD = 1.722$$

$$RM2 = 60.753 + 0.410\ RY - 52.216\ RM + 403.078\ RS \qquad (1.2,P2)$$
$$(55.923)\quad (0.165)\qquad (230.929)\quad (278.738)$$

$$- 159.255\ T + 1.611\ RM21 + 117.511\ D76$$
$$[125.424]\quad (0.972)\qquad (79.466)$$

$$\bar{R}^2 = 0.995;\quad h = \text{undefined};\quad SD = 14.682$$

Regression (1, P2) indicates a high level of goodness of fit as its adjusted R-square for degrees of freedom is approaching one. It indicates also a very low level of (MAPE) and (SD) compared with the corresponding values arised from estimating demand for money narrowly defined in the first period and the whole period. Serial correlation in this regression is absent, based on the Durbin h-test. All variables are highly significant.

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[12] When the function is estimated in log-linear form RS and D76 become not significant.

With respect to the demand function for money broadly defined, it is found that all independent variables, when run in the regression together, are not significant and (RM) has the lowest t-value. However all these variables have the correct signs. When the variable (RM) is ommitted from the regression (1.2, P2), the estimated coefficient of (RY) is the only significant one at 5 per cent level while the coefficient of other independent variables are significant at a level between (9-15) per cent. With respect to the lagged dependent variable in regression (1.2, P2), it seems to not be relevant as it has a coefficient greater than one which violates our assumption that the adjustment coefficient should be between zero and one. The coefficient of the lagged dependent variable becomes reasonable only when the time trend variable is omitted, which means that time trend variable is wrongly specified in this regression as follows:

$$RM2 = \underset{(17.665)}{-16.959} + \underset{(0.032)}{0.209}\,RY + \underset{(0.117)}{0.393}\,RM21 \qquad (1.21,P2)$$

$$\bar{R}^2 = 0.994; \quad h = 0.159; \quad SD = 18.178$$

Thus the coefficients of these two independent variables become highly significant except the intercept coefficient which is not significant at a reasonable level.

However, it is found more appropriate to estimate demand function for (RM2) in log-linear form during this period. The results are as follows:

$$LRM2 = \underset{(0.379)}{-1.706} + \underset{(0.109)}{0.758}\,LRY - \underset{(0.330)}{1.555}\,RM \qquad (1.211,P2)$$

$$+ 0.125\ RS + 0.395\ LRM21 - 0.037\ D76$$
$$(0.103) \quad (0.086) \quad (0.050)$$
$$\bar{R}^2 = 0.996; \quad h = -0.385; \quad SD = 0.039$$

This regression indicates that most variables are significant, except RS and D76, and the (MAE/$\bar{Y}$) is equal to only 0.33 per cent.

When the quarterly data are used during the second period the estimated demand function for RM1 shows a lower level of significance with respect to variables RM, RS and RG. The latter also has a wrong sign, while the estimated demand function for RM2 is more plausible than that which is applied to the annual data. Here two more variables, RM and RS become significant in addition to real income and the lagged dependent variable. These two regressions are:

$$RM1 = 24.341 + 0.043\ RY - 183.968\ RM + 77.097\ RS \qquad (1,P2,Q)$$
$$(14.007) \quad (0.018) \quad (151.498) \quad (55.324)$$

$$+ 0.150\ RG + 0.614\ RM21 + 29.111\ D76$$
$$(0.085) \quad (0.099) \quad (14.213)$$
$$\bar{R}^2 = 0.983; \quad h = -1.062; \quad SD = 20.615$$

$$RM2^* = -5.309 + 0.075\ RY - 374.455\ RM \qquad (1.2,P2,Q)$$
$$(6.163) \quad (0.012) \quad (137.144)$$

$$+ 88.764\ RS + 0.781\ RM21$$
$$(45.201) \quad (0.045)$$
$$\bar{R}^2 = 0.988; \quad \rho 1 = -0.500; \quad h = -2.678; \quad SD = 19.646$$

Regression (1,P2,Q) is free of serial correlation while regression (1.2,P2,Q) is corrected for serial correlation.

Now to sum up, Table XI shows the comparisons among selected regressions.

TABLE XI

COMPARISON BETWEEN SELECTED REGRESSIONS DURING DIFFERENT PERIODS

Period	RM1			RM2		
	$\frac{MAE}{\bar{Y}}\%$	MAPE	SD	$\frac{MAE}{\bar{Y}}\%$	MAPE	SD
1) Annual data:						
1961-1969	1.92	2.78	2.057	3.35	4.00	4.102
1969-1977	0.14	0.14	1.722	3.09	4.06	18.178
1962-1977	1.66	4.00	6.916	1.71	2.40	9.675
2) Quarterly data:						
1962.1-1969.2	6.63	7.13	5.693	5.06	5.07	5.630
1969.3-1977.4	4.03	4.57	20.615	3.91	4.50	21.502
1962.1-1977.4	4.12	4.66	14.458	4.24	5.28	15.629

Note: These statistics are calculated before the correction for serial correlations, if there are any.

Now if the measurement of errors is considered whether ($MAE/\bar{Y}$) or MAPE, the regressions of the whole period are still preferable if a simulation is needed within this period. But if forecasting is needed before or after this period, then it is recommended that equations of the first period for back casting be used and equations of the second period for future forecasting be used. That is such forecasting will be with a lower level of errors, especially with respect to (RM1), as its percentage error is lower than 5 per cent except that of the first period when quarterly data is used. Table XI shows that those regressions estimated with annual data are more accurate than those estimated with quarterly data. This is a result of our limitation that the quarterly data of real income and real development expenditures are interpolated as they are not available on the quarterly basis. However for saving time on one hand and because there are at least two variables to be interpolated in each equation, it is likely not to continue to estimate the other equations of the model with a quarterly data since the annual data has given more accurate results as mentioned above.

Demand Elasticities of Monetary Variables

Since this study concerns mostly the role of money in the Libyan economy, it is preferable to give more attention to the money demand elasticities with respect to real income (RY), opportunity cost of holding money (RM) and the opportunity cost of holding other alternative assets (RS), it is housing in this study.

In this section the analysis of elasticities of money demand functions (aggregated and disaggregated) is discussed in detail, as these elasticities become very useful to policy makers, because their values are independent of the units in which the variables are measured.

Those elasticities which are shown in Table XII and Table XIII are calculated at the points of the means of each independent variable when the regression is estimated in its linear form. But when these regressions are estimated in semi-log linear form, the income elasticity is the coefficient of the independent variable (LRY) while the elasticities of RM and RS as they are not in log forms, are calculated as follows:

$$E(RMI,RM) = \frac{d(RMI)}{d(RM)} \cdot \frac{RM}{RMI} = \frac{1}{d(RM)} \cdot \frac{d(RMI)}{RMI} \cdot RM$$

$$= \frac{d(\ln RMI)}{d(RM)} \cdot RM = \hat{B} \cdot \overline{RM}$$

Thus the point elasticity, in this case, is the product of the estimated coefficient and the mean value of the independent variable (80, p. 60). And when a lagged dependent variable is included in the regression the calculated elasticity is reduced to the status of short run elasticities (Esr). Therefore the long run elasticity (Elr) would have to be calculated in each regression by dividing the coefficient of the variable by the adjustment coefficient (λ) which equals one minus the coefficient of the lagged dependent variable.

The long run elasticity equals the short run elasticity divided by the adjustment coefficient. So when the adjustment coefficient equals unity, the short-run and long-run elasticities are equal.

But calculating the long run elasticity produces two error terms, the coefficient standard errors of the independent variable and the lagged dependent variable. So the standard error of the long run elasticity is obtained by dividing the standard error of the short-run elasticity by the adjustment coefficient.

$$S_{Elr} = S_{Esr/\lambda}$$

The same procedure is done for calculating the standard error of elasticity derived from a linear regression, based on the assumption that the ratio of the par values of two variables (within a sample) is constant[13].

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[13] The reader is cautioned that this procedure is not strictly legitimate because the par value of dependent variable is not a constant.

Table XII shows money demand elasticities with respect to RY, RM and RS during the whole period. When the annual data are used with respect to the two different definitions in linear forms, the money demand-income elasticity is statistically different from one, it is greater than one which leads to the conclusion that money is a "superior good" in Libya. But when these two types of money are estimated in semi-log linear form, the two money definitions (RM1 and RM2) have an income elasticity greater than one, but they are statistically not different from one, which means that the income unitary elasticity of the money demand classical model holds in Libya. However, since these equations are more appropriate in its semi-log linear form, it is likely to consider those elasticities calculated from these equations which are more accurate and more plausible, and hence it can be said safely that the classical income unitary elasticity of money demand holds in Libya with respect to RM1 and RM2. The income elasticity of demand for real time and saving deposits (RTS) amounts to 2.0 and it is statistically different from one, but these deposits are included in (RM2) which also shows an income elasticity not different from one. The table shows also different results of elasticities with respect to demand for demand depostis when such a function is estimated in linear form or semi-log linear form. The income elasticity of RDD is not different from one when it is estimated in linear form and different from one when it is estimated in semi-log linear form. But of some interest is that the (RDD) in its linear form using quarterly data gives an elasticity of (0.549) which is statistically not different from one half leading to the conclusion that demand for demand deposits belongs to the "transaction model". That is opposite of what we earlier found. However, it is

TABLE XII

ELASTICITIES OF MONEY DEMAND FUNCTIONS WITH RESPECT TO RY, RM AND RS DURING THE WHOLE PERIOD (1962-1977)

Dependent variable	Annual Data			Quarterly Data		
	RY	RM	RS	RY	RM	RS
Linear equations						
RCC	0.584[1]	N.S.	0.030	2.170[1,2]	-0.029	N.S.
RDD	1.048[2]	-0.086	0.043	0.549[1]	N.S.	N.S.
RM1	1.397[3]	-0.076	0.043	0.532[1]	N.S.	N.S.
RTS	2.000[3]	N.S.	N.S.	1.528[3]	N.S.	N.S.
RM2	1.315[3]	-0.053	0.034	1.226[2]	-0.062	0.032
Semi-log linear equations						
LRCC	1.752[1,2]	N.S.	0.025	1.030[2]	-0.197	N.S.
LRDD	1.396[3]	-0.082	0.038	1.272[2]	-0.127	0.051
LRM1	1.356[2]	-0.076	0.027	1.178[2]	-0.114	0.036
LRTS	N.S.	N.S.	N.S.	0.979[2]	N.S.	N.S.
LRM2	1.112[2]	-0.064	0.027	0.845[2]	-0.074	0.029

[1]It is not statistically different from one half (Baumol model).

[2]It is not statistically different from one (the classical model).

[3]It is different from one.

N.S.: not significant

likely to reject this result since other regressions of RDD using annual and quarterly data do not support this result. This result is also shown by RMI in its linear form using quarterly data, and it is rejected based on the same reasoning. While the demand for currency showed three times that its income elasticity, statistically it is not different from one half, leading to the conclusion that demand for currency in Libya belongs to the "transaction model" especially as it is found highly significant when the total value of transactions is used as an argument for the income proxy. Then in general all equations of the aggregate (and disaggregate) demand for money when they are estimated in semi-log linear form and using quarterly data, regardless of the definition of money, showed different elasticities which all are statistically not different from one, leading to the conclusion that demand for money in Libya regardless of the definition of money, belongs to the classical unitary income elasticity of demand for money. In the log form the income elasticity amounted to 1.178 and 0.845 with respect to RM1 and RM2, respectively. The large elasticities of course, imply that the dependent variable is very responsive to changes in the independent variable. But regarding the inter equation, differences in the elasticity of common variables are very small and statistically insignificant at the 5 per cent level. For example the income elasticity of (RDD) is less than that of the (RM1) as shown by their linear forms, but the t-value of the difference is equal only to (0.220)[14]. The income elasticity of

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[14]In his dissertation, Moufti (80, p. 62) tested the significance of a difference between elasticities drawn from two equations by deriving the relevant standard error as the root square of the sum of the two elasticities variances. The same procedure is followed here, assuming that the two elasticities are independent, thus,

$$\text{var } (E_1 - E_2) = \text{var } (E_1) + \text{var } (E_2).$$

(RTS) is greater than the more inclusive money (RM2) but their difference is not significant as its t-value equals (0.353). The significance of the difference between elasticities of (RM2 and RM1) is also investigated and found not significant, leading to the fact that they are approaching equality regardless of the definition of money.

The income elasticity is also investigated during the two periods of analysis (Table XIII). Using annual data in the linear form, the income elasticity of RMI is statistically different from one during both periods amounting to 1.844 and 1.896 for the first and second periods, respectively while the income elasticity of the more inclusive money (RM2) is not statistically different from one. But of interest is the fact that when the quarterly data is used most equations appear with elasticities statistically not different from one half, regardless of the definition of money, aggregated or disaggregated model, during the two separated periods. Some exceptions of this result are the income elasticities of (RM2, linear) during the second period, (RM2, log linear) during both periods, and (RTS, linear) during the second period. Thus, in general the income elasticities lead to the conclusion that demand for money regardless of the definition of money, belongs to the transactions model during the first period in which the opportunity cost of holding money was insignificant for most equations. But it is interesting to note that when the income elasticity of RDD is not significant, the opportunity cost elasticity of RDD is highly significant and is not different from one half, which also hold the characteristic of the Baumol model. But it is not safe to take this result as it may come by chance, since the opportunity cost elasticities are very low

TABLE XIII

ELASTICITIES OF MONEY DEMAND FUNCTIONS WITH RESPECT TO RY, RM AND RS DURING THE FIRST AND SECOND PERIODS

Dependent Variables	First Period			Second Period		
	RY	RM	RS	RY	RM	RS
Annual data (linear)[4]						
RM1	1.844[3]	N.S.	N.S.	1.896[3]	-0.098	0.016
RM2	1.082[2]	N.S.	N.S.	1.175[2]	N.S.	N.S.
Quarterly data;						
Linear equations						
RM1	0.488[1]	N.S.	N.S.	0.495[1]	N.S.	N.S.
RM2	0.622[1]	N.S.	N.S.	1.261[2]	-0.053	0.014
RCC	0.390[1]	N.S.	N.S.	0.444[1]	N.S.	N.S.
RDD	N.S.	-0.548[1]	N.S.	0.522[1]	N.S.	N.S.
RTS	0.849[1,2]	-0.100	0.090	1.870[3]	N.S.	N.S.
Semi-log-linear						
LRM1	0.434[1]	N.S.	N.S.	0.302[1]	N.S.	N.S.
LRM2	0.744[3]	N.S.	N.S.	0.852[2]	-0.052	0.025

N.S.: not significant.

[1]it is not statistically different from one half (Baumol model).

[2]it is not statistically different from one (the classical model).

[3]it is statistically different from one.

[4]The income elasticity of both (RM1 and RM2) is statistically unitary when the functions are estimated in their semi-log linear form during each period.

in the other equations ranging between 0.029 to 0.197, excluding that of (RDD) during the first period which amounts to (-0.548). The significance of the difference between opportunity cost elasticities of holding money is also investigated in those semi-log linear equations (using quarterly data), and found not significant regardless of the definition of money and the aggregated or disaggregated model.

But it is interesting to report a conclusion which was indicated by Deaver (29, p. 11) on the Chilean economy. He found that income elasticities estimated with quarterly data are less than one, and when the whole period is broken into shorter periods, income elasticities become lower than for the period as a whole. In this study most results of income elasticites confirm the Deaver's conclusion, except that of RM1 (linear), estimated with annual data show a higher income elasticity when the period is broken into two periods, than for the period as a whole.

Another view which is likely to be mentioned, that the demand for real demand deposits, real currency, and for real money narrowly defined, in general, is more sensitive to changes in the cost of holding money, than that for more inclusive money. The cost elasticity estimated with quarterly data (semi-log linear) of demand for currency amounted to (-0.197), the cost elasticity of demand for demand deposits and for RM1 amounted to (0.127) and (-0.114) respectively, while the cost elasticity of demand for RM2 is lower reaching a level of (-0.074). Thus as the cost elasticity of RM2 is lower than that of RM1, the inclusion of time and savings deposits are poor money substitutes, while currency is definitely a very good money substitute, followed by demand deposits.

To sum up, the main results are the following: (1) Using annual data, the classical income unitary elasticity of money demand holds in Libya with respect to RM1, RM2 and RDD. The income elasticity of demand for currency is statistically not different from one half, hence the demand for currency in Libya belongs to the "transaction model". The income elasticity of demand for (RTS) amounts to 2.0 which is statistically different from one. This high level of income elasticity suggests that (RTS) is a "superior good" in Libya. (2) But using quarterly data, the classical income unitary elasticity of money demand (aggregate and disaggregate) holds in Libya regardless of the definition of money. (3) The analysis by period indicates that using annual data, the income elasticity of RM1 is statistically different from one during both periods, (linear) while the income elasticity of the more inclusive money (RM2) is not statistically different from one. But by using the quarterly data, the income elasticity of (RM1) appeared to be statistically not different from one half, regardless of the definition, aggregated or disaggregated model, during the two separate periods. The income elasticity of (RM2) is statistically different from one in the first period and not different from one in the second period. (4) The income elasticities estimated with quarterly data are, in general less than those estimated with annual data, and less than one with respect to RDD, RM1, LRTS and LRM2. When the whole period is broken into shorter periods most income elasticities become lower than for the period as a whole. (5) The demand for real demand deposits, real currency, and real money narrowly defined, in general, is more sensitive to changes in the opportunity cost of holding money, than that for more inclusive money. Thus the inclusion of time and saving deposits are poor money substitute, while currency is definitely a very good money substitute, followed by demand deposits.

Stability of the Demand Function for Money

The stability of the money demand function equation over time during the whole period is investigated. The Chow (28, p. 598) ratio which is distributed as F (K, n+m-2K) under the null hypotheses that both groups of observations are consistent with the whole sample data is used. The whole period is divided into the two periods, taking (Sept. 1969) as the time point of division. So the second period started from the first September of 1969 when the quarterly data are considered. But when annual data are used, 1969 is included in each period, and 1961 is added to the first period in order to have an appropriate number of degrees of freedom in each period. The stability investigation is concentrated on the main equations of money demand functions namely: demand for real money balances in its both definitions (M1 and M2) and in its both forms: linear and semi-log linear. The Chow ratio is taken from two linear regression with equal (K) parameters (K-1 coefficients plus one intercept), and the number of observations are (n) for the first period, (m) for the second period and (n+m) for the whole period. Then as shown by table (XIV) the Chow ratio is not greater than the tabulated F ratio in each case. Consequently it is safe to conclude that the observations before and after 1969 do not come from a different structure at the five per cent level of significance. That is to say they are consistent within the whole period sample data, and hence the money demand function in Libya is stable during the period 1962 to 1977, and the observations (m) are governed by the same relationship as before. This conclusion is also supported by the above discussion on the income elasticities, estimated during the different periods, as they were found not significantly different from each other. A glance to F ratio of both definitions of money, seems to indicate that the more inclusive money (RM2) is less stable than that of less inclusive money. This difference in the stability level may arise from the instability of the demand for time and savings deposits. However, the stability of demand for money is widely accepted and approved by famous economists such as Friedman (38) and Goldfeld and Modegliani (47).

TABLE XIV

TEST FOR STABILITY OF MONEY DEMAND FUNCTION (CHOW TEST)

Equation form	K	RM1 annual data	RM1 quarterly data	RM2 annual data	RM2 quarterly data
Linear	3	0.99[1]	0.77[2]	2.93[1]	1.13[2]
Linear	5	2.06[3]	0.71[4]	2.17[3]	0.97[4]
Semi log linear	5	1.94[3]	1.95[4]	1.50[3]	2.20[4]

(K) is the number of parameters (K-1 coefficient plus one intercept).

[1]Compared with tabulated $F(3,10) = 3.71$; at level 5% of significance.

[2]Compared with tabulated $F(3,57) = 2.77$; at level 5% of significance.

[3]Compared with tabulated $F(5,6) = 4.39$; at level 5% of significance.

[4]Compared with tabulated $F(5,53) = 2.39$; at level 5% of significance.

A Test of the Linear Homogeneity Assumption

This assumption is the classic one, that the quantity of money demanded in nominal terms is homogeneous of degree one in prices. However this assumption becomes testable. The money demand functions (narrowly defined) are investigated in this respect, and all experiments show that the coefficient of (LP = log P) is not significantly different from one, leading to the conclusion that demand functions for real money balances are appropriate to be estimated in this study.

After including the price variable (LP), the results are:

a) with annual data

$$\underset{}{LMI} = \underset{(0.607)}{-1.183} + \underset{(0.107)}{0.621}\ LRY + \underset{(0.455)}{1.350}\ LP - \underset{(0.432)}{1.124}\ RM$$

$$+ \underset{(0.139)}{0.253}\ RS - \underset{(0.0002)}{0.0002}\ RG + \underset{(0.134)}{0.411}\ LRM11 + \underset{(0.068)}{0.125}\ DR;$$

$$\bar{R}^2 = 0.999; \quad h = -1.405; \quad SD = 0.051$$

b) with quarterly data

$$LMI^{*} = \underset{(0.136)}{-0.324} + \underset{(0.040)}{0.176}\ LRY + \underset{(0.087)}{1.082}\ LP - \underset{(0.236)}{1.342}\ RM$$

$$+ \underset{(0.104)}{0.313}\ RS + \underset{(0.039)}{0.830}\ LRM11 + \underset{(0.020)}{0.038}\ DR;$$

$$\bar{R}^2 = 0.998; \quad \rho 1 = -0.495; \quad h = -3.970; \quad SD = 0.049$$

This regression is corrected for serial correlation by the non-linear least square method. The coefficient of the price variable, whether the equation is estimated with annual data or quarterly data, indicates that the coefficient is not statistically different from one, leading to the conclusion that the linear homogeneity assumption holds in the case of Libya. The Goldfeld (47, p. 625) test[15] in this respect, was conducted and the equations were estimated with both annual and quarterly data showing the coefficient of price variable insignificantly different from zero which leads to the same above conclusion approved by regressing the quantity of money in nominal value on the whole independent variables mentioned above.

A Test of the Linear Homogeneity Assumption in Population

Some economists indicated that demand for money is also homogeneous of degree one in population. That is to say, the demand function may be estimated as the demand for per capita real money is a function of per capita real income (ARY) and other appropriate arguments such as the interest rate. Thus the best fitted function of demand for money narrowly defined, with annual data is estimated after introducing a new argument of the number of population (N):

$$\underset{(0.313)}{LRM1 = -1.515} + \underset{(0.100)}{0.634\ LARY} + \underset{(0.341)}{0.337\ LN} - \underset{(0.368)}{0.977\ RM}$$

$$+ \underset{(0.115)}{0.170\ RS} + \underset{(0.118)}{0.527\ LRM11} + \underset{(0.066)}{0.099\ DR};$$

$$\bar{R}^2 = 0.998; \quad h = -0.889; \quad SD = 0.052$$

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[15] Estimate the original equation after adding the price variable and test the hypothesis that the coefficient of price variables is equal to zero, so that one cannot reject the unitary price elasticity if the coefficient is insignificantly different from zero.

The coefficient of population is not significantly different from zero, but significantly different from unity. Thus deflation by population does not seem to be appropriate. Golsfeld's (47, p. 625) test for such hypothesis was also conducted. His procedure is to estimate the same function after inclusion of the population variable, and the hypothesis is rejected if the coefficient of population is insignificantly different from zero, or when this coefficient is equal to unity less the coefficient of real income and the coefficient of the lagged dependent variable. So the money demand function is estimated as follows:

$$LRMI = -1.852 + 0.728\ LRY - 0.955\ RM + 0.181\ RS$$
$$\quad (0.409) \quad (0.124) \qquad (0.358) \qquad (0.112)$$

$$+ 0.478\ LRM11 + 0.106\ DR + 0.382\ LN;$$
$$(0.121) \qquad (0.064) \qquad (0.334)$$

$\bar{R}^2 = 0.998$; $h = -0.077$; $SD = 0.050$

Thus the equation reveals that the coefficient of population is insignificantly different from zero, which suggested that the assumption of a linear homogeneity in population is not valid for the case of Libya. Another experiment is done on the number of households rather than of persons as suggested by OKun (47, p. 645) and the above conclusion still holds. However, if the income proxy is the only argument in the money demand function, then such a function reveals a unitary elasticity of population as shown by the following function:

$$LRM1^{*} = 0.800 + 0.597\ LARY + 1.688\ LN;$$
$$(1.622) \quad (0.174) \qquad (0.665)$$

$R^2 = 0.552$; $D.W. = 1.386$; $\rho 1 = 0.9$; $SD = 0.092$

This equation is corrected for serial correlation. The coefficient of population is not statistically different from one, leading to the conclusion that demand for real money is unitary elastic with respect to the population. But even here it is not safe to be considered, especially the multiple correlation of the regression (R^2) is very low.

White (66, p. 603) indicated that "only in the special case in which real income elasticity of demand for money approximates unity, can the deflation by population be ignored." It seems this is the case of Libya since most income elasticities, as discussed earlier, are not different from unity at 5 per cent level. Of interest is the fact that other studies did not show good results in this respect, such as that of Goldfeld (47, p. 625), despite the deflation by population has a strong theoretical grounding.

CHAPTER VI

ESTIMATION OF THE MODEL

Estimation of the demand for money has been done in the previous chapter. Therefore this chapter concentrates on the estimation of the remaining eight behavioral equations, using only annual data. Analysis by the period shall also continue for each equation. Each equation is estimated by the ordinary least square (OLS) method in both linear and log-linear forms. Then the single equation model of the balance of payments is also estimated at the end of this chapter in order to check whether it is valid for the case of Libya or not. SAS program is also used in this chapter to estimate the model.

Domestic Price Level

The price level equation is estimated in its linear form by the ordinary least squares method, and the results are as follows:

$$P = \underset{(0.462)}{-1.836} + \underset{(0.489)}{2.667}\ PWC - \underset{(0.445)}{2.839}\ DS.PWC + \underset{(0.057)}{0.227}\ Ph \qquad (1)$$

$$+ \underset{(0.004)}{0.023}\ MX1 + \underset{(0.459)}{3.011}\ DV$$

$$\bar{R}^2 = 0.985; \ D.W. = 1.396; \ \bar{\rho} = 0.269; \ SD = 0.046$$

where P denotes the price level, PWC denotes the import prices in home currency, DS denotes a dummy variable equal to one for years greater than 1970 and zero otherwise, representing the subsidy given by the government on main foodstuff items, Ph denotes the price level in the housing sector, MX1 is an index number for money narrowly defined (1964 = 1.00) and denotes the demand pull inflation, and DV is a dummy variable (DV = DS) for capturing the demand pull inflation arising from the huge development expenditures during the period (1971-1977).

This equation shows no conclusive evidence of serial correlation ($\bar{\rho}$). All independent variables are significant. The ratio of absolute mean error to the dependent mean value is 2.19 per cent leading to the conclusion that this equation is very plausible and appropriate for the whole model. The signs are also as expected and support the theoretical view. Thus the price level behavior in Libya is affected positively by imported inflation (PWC), domestic inflation (Ph) and demand pull factors (MX1) and (DV). The price level is negatively related to the subsidy paid by the government for some necessary consumer goods. That is, the slope between the price level and the world price in home currency is 2.667 during the period 1962-1970, and from 1971 to 1977 it is corrected by the subsidy effect (DS.PWC) making the coefficient negative in the latter period (2.667-2.839). With respect to demand pull inflation, it is found that (MX1) is a good proxy for it, while when the government development expenditure is used (G) it deteriorates the significance of other independent variables. The other factors affecting the shift in demand is captured by the dummy variable (DV) which represents not only the huge increase in development expenditures, but also other measures conducted by the government such as limiting quotas for some imported goods and establishing government monopoly in imports which increased gradually since 1971.

Here it should be noted that since PWC = PMC*E, the foreign price and the exchange rate were tried in place of the world price in domestic currency, but the results were implausible as the exchange rate was insignificant and had a negative sign which is contrary to the expected sign[1]. Then if the exchange rate is omitted the equation becomes more plausible if the level of percentage error $[(MAE/\bar{Y}) = 0.0133]$ is concerned, and the foreign price index (PMC) becomes a good proxy for price imports in domestic currency. But this equation is ignored, because such a result may arise by chance and is not based on theory. The above equation is also very plausible and the difference between the percentage errors is negligible. The price level is adjusted within the period (one year), as the coefficient of the lagged dependent variable is insignificantly different from zero.

The price function is also estimated in its semi-log-linear form and the results are as follows:

$$\underset{}{LP} = \underset{(0.019)}{0.053} + \underset{(0.404)}{2.053}\ LPWC - \underset{(0.364)}{2.247}\ DS.LPWC + \underset{(0.064)}{0.309}\ LPh \qquad (1.1)$$

$$+ \underset{(0.003)}{0.012}\ MX1 + \underset{(0.036)}{0.159}\ DV$$

$$\bar{R}^2 = 0.980;\ D.W. = 1.312;\ \bar{\rho} = 0.310;\ SD = 0.035$$

where L is added to the variable to denote log.

There is no conclusive evidence whether the serial correlation is

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[1]This result is also confirmed by Kwack (69) as noted earlier in Chapter IV. That is the continuous increase in world inflation tends to offset the initial negative effect on domestic inflation, caused by the Dinar appreciation.

present or absent in this equation. All independent variables are significant and have the correct signs. However this equation is less plausible than the linear equation (1) if the percentage error ($MAE/\bar{Y}$) is concerned, as this equation has a percentage error of 6.55 per cent which is a little bit higher than the a priori acceptance level of 5 per cent. Thus equation (1) is not only plausible but also is appropriate to be included in the whole model. In the chosen equation the price elasticities with respect to (PWC), (Ph) and (MX1) are 2.324, 0.267 and 0.137 respectively, while the corresponding elasticities as shown in the semi-log linear form amounted to 2.053 with respect to (PWC), 0.309 with respect to (Ph) and 0.111 with respect to (MX1). However the difference between each elasticity calculated from the above two equations is insignificantly different from zero.

When period analysis is investigated, the imported inflation variable is found during the first period to be significant only at level 16.8 per cent. This is a satisfactory result since the world inflation was normal and slowly increasing during the sixties, compared to that of the seventies when it was increasing at a higher rate. The other two independent variables representing domestic inflation and demand pull inflation appear to be very significant as shown from the following equation:

$$P = \underset{(0.370)}{0.025} + \underset{(0.413)}{0.695}\, PWC + \underset{(0.078)}{0.275}\, Ph + \underset{(0.017)}{0.051}\, MX1 \qquad (1,P1)$$

$$\bar{R}^2 = 0.987;\ D.W. = 2.994;\ \bar{\rho} = -0.504;\ SD = 0.019$$

This equation shows no conclusive evidence of serial correlation.

But it is interesting to note that this equation shows a very low percentage error (MAE/$\bar{Y}$) amounting only to 0.83 per cent. However, when the price function is estimated in its semi-log linear form, no new information is added except that it has a higher percentage error amounting to 5.38 per cent.

$$LP = -0.004 + 0.545\ LPWC + 0.347\ LPh + 0.035\ MX1 \qquad (1.1,P1)$$
$$(0.013)\quad (0.378)\qquad (0.090)\qquad (0.014)$$
$$\bar{R}^2 = 0.987;\ DW = 3.086;\ SD = 0.016$$

Of interest is the fact that the price of housing becomes insignificantly different from zero during the second period. This is because the housing assets have lost their characteristic as an alternative asset for money. That is to say, people have given up holding houses as wealth and instead they increased their holdings of money (hoarding) as wealth. The dummy variable (DV) is also found insignificant. Therefore both variables (Ph, DV) are omitted from the following price function (1,P2) of the second period.

$$P = 1.118 + 0.285\ PWC - 0.107\ DS.PWC + 0.022\ MX1 \qquad (1,P2)$$
$$(0.078)\quad (0.083)\qquad (0.031)\qquad (0.003)$$
$$\bar{R}^2 = 0.984;\ D.W. = 2.068;\ \bar{\rho} = -0.160;\ SD = 0.031$$

There is no conclusive evidence of serial correlation in this equation and all remaining independent variables are highly significant. In addition this regression is plausible and appropriate as it gives a low level (1.26 per cent) of percentage error (MAE/$\bar{Y}$). Then when the price function of this period is estimated in its semi-log linear form, it is also found plausible and appropriate as all the independent variables are highly significant, but it differs in that the percentage error ($MAE/\bar{Y}$) is a little bit higher (2.17 per cent).

$$LP = 0.294 + 1.102\ LPWC - 0.928\ DS.LPWC + 0.012\ MX1 \qquad (1.1,P2)$$
$$(0.015)\ (0.263)\qquad (0.239)\qquad (0.001)$$
$$\bar{R}^2 = 0.985;\ D.W. = 2.054;\ \rho = -0.118;\ SD = 0.017$$

This equation is free of serial correlation based on the Durbin-Watson statistics. Table XV summarizes the price elastocities with respect to independent variables. When the price elasticity with respect to (PWC) is corrected by the subsidy proxy during the period (1971-77), it becomes negative (-0.194) as shown in the estimates of the whole period, or positive (0.174) as shown in the estimates of the second period.

TABLE XV

PRICE ELASTICITIES WITH RESPECT TO (PWC), (Ph) AND (MX1)

Elasticity and Equation Form	First Period	Second Period	Whole Period
1) E(P,PWC)			
a) Linear form	0.583[1]	0.249	2.324
b) Semi-log linear form	0.545[2]	1.102	2.053
2) E(P,PH)			
a) Linear form	0.310	N.S.	0.267
b) Semi-log linear form	0.347	N.S.	0.309
3) E(P,XM1)			
a) Linear form	0.087	0.186	0.137
b) Semi-log linear form	0.072	0.169	0.111

N.S. = not significant at all

[1]Significant at level 16.8 per cent

[2]Significant at level 22.3 per cent

The price elasticity with respect to the imported inflation (PWC) is approaching unity (1.102) compared to that of linear form which amounts only to 0.249. The difference between these two elasticities is significantly different from zero while the difference between price elasticities with respect to (MX1) calculated from these mentioned equations is insignificantly different from zero.

The Price Index of Housing (Ph)

The percentage change in the price index of housing is considered as an independent variable in the money demand function and has a positive sign since holders of wealth in Libya may prefer to hold housing assets rather than money. So houses and other buildings became an alternative asset to money and its price is positively related to the money demand function. The price function of housing is linearly estimated and the results are as follows:

$$\underset{}{Ph} = \underset{(0.360)}{-0.398} + \underset{(0.0004)}{0.001\,W} + \underset{(0.386)}{1.221\,PWB} + \underset{(0.040)}{0.104\,MX1} \qquad (2)$$

$$\underset{(0.031)}{-\ 0.144\,DR.MX1}$$

$$\bar{R}^2 = 0.952;\ D.W. = 2.530;\ \bar{\rho} = -0.405;\ SD = 0.140$$

Where W is the nominal average wage representing the cost push inflation, PWB is the import price of building materials in home currency (PWB = PB.E) representing the imported inflation to the housing sector, MX1 is an index number of (M1) representing the demand pull inflation. DR is a dummy variable equal to one for years greater than 1969 and zero otherwise. It represents the social ideological change associated with the First of September Revolution. That is most people who prefered to hold wealth in the form of housing started to shift to more liquid assets (money), so the trend toward hoarding was encouraged.

There is no conclusive evidence of serial correlation in this equation. All independent variables are significant. However the dummy variable (Dh) representing the big increase in number of building and apartments which are built by the government, and other measures such as factors affecting the supply of houses namely reducing the old rents twice during a period of three years (1970-1973) is omitted from the equation because it is found insignificantly different from zero and with a positive sign. This result, however, arose from the fact that all houses built by the government were distributed to those families who were not a partner in the effective demand for housing. That is to say, they were living in tents or slums. With respect to reducing rents, it was subject to old rents only, while the new rents of new houses continue to go up, despite the fact that there is a law indicating a fixed level of rents for new houses and buildings.[2]

The price of housing is not wholly representing the domestic inflation, as the non-tradeable goods (housing) is produced by a high percentage contribution from imported building materials. So the price of housing is affected by the import price of building materials

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[2]The annual rent is calculated as a seven per cent of the total value cost of the house excluding land plus two per cent of the land value. However the above mentioned measures discouraged private investment in this sector, resulting with a lower level of supply and a higher level of prices.

(PWB).[3] The cost push inflation (W) is significant and it has the expected positive sign, demand pull inflation variable (MX1) is also positively related to prices of housing, and shows a high level of significance. That is to say an increase in money balances will lead to a right hand shift in the demand for housing causing the price to go up.

(DR.MX1) is a variable included in order to correct the slope of (MX1) with respect to (Ph). The sign of (DR.MX1) variable is negative as expected, indicating that a part of the money increase is allocated for hoarding or for purchasing durable goods and expensive metals as gold and silver. The variable is at the highest level of significance in this equation (0.0007). The lagged dependent variable is omitted because it is found insignificant, and hence the desired price level of housing is adjusted during the same period. In general the equation is plausible and appropriate as its mean absolute percentage error is approaching the five per cent level (5.29 per cent), and it is consistent with the theory of demand pull-cost push inflation.

The price function of housing is also estimated in its semi-log linear form as follows:

$$\underset{}{LPh} = \underset{(0.283)}{-1.190} + \underset{(0.051)}{0.225}\ LW + \underset{(0.271)}{1.062}\ LPWB + \underset{(0.017)}{0.087}\ MX1 \tag{3.1}$$

$$- \underset{(0.016)}{0.094}\ DR.MX1$$

$$\bar{R}^2 = 0.966;\ D.W. = 2.270;\ \bar{\rho} = -0.157;\ SD = 0.069$$

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[3] Here it is found also that the exchange rate is not significant, so it is included in the foreign price of imports in order to show the price of imports in domestic currency (PWB).

Equation (2.1) is also inconclusive evidence of serial correlation, and all independent variables are significant except the dummy variable (Dh) which is omitted from the equation as it is insignificantly different from zero even with a negative sign. This equation, however, is inferior if it is compared with equation (2). In equation (2.1) the ratio of (MAE) to mean dependent variable is 8.63 per cent and the mean absolute percentage error is 19.72 per cent compared to the corresponding percentage errors, 5.33 per cent and 5.29 per cent respectively in equation (2).

The price function of housing is also estimated for the first period alone, and it is found that the cost push variable is insignificantly different from zero, so it is omitted from the function in this period. However its omission is reasonable since the contribution of housing production in GNP is relatively low. The industries producing building materials are also small and in their first stage of development. The results of the estimated equation are as follows:

$$Ph = -3.935 + 4.845\ PWB + 0.164\ MX1 \qquad (2,P1)$$

$$(2.478) \quad (2.510) \qquad (0.052)$$

$$\bar{R}^2 = 0.906;\ D.W. = 1.881;\ SD = 0.103$$

Serial correlation is absent in this equation, and only the money variable is significant at lower than 5 per cent (2.54 per cent), while the imported inflation (PWB) in the field of housing production is significant at lower levels, amounting to 11.15 per cent. This is because the world inflation was not very high during this period. But when the equation is estimated in its semi-log linear form (2.1,P1), the variable (PWB) gains a higher level of significance (5.85 per cent).

But if the percentage error is concerned, the linear form (2,P1) of this equation is more preferable and appropriate as the ratio ($MAE/\bar{Y}$) is 3.89 per cent compared to 15.88 per cent in the semi-log linear form (2.1.P1).

$$LPh = \underset{(0.054)}{-0.042} + \underset{(1.798)}{4.392}\ LPWB + \underset{(0.037)}{0.107}\ MX1 \qquad (2.1,P1)$$

$$\bar{R}^2 = 0.924;\ D.W. = 1.872;\ SD = 0.073$$

This equation is free of serial correlation.

Then the Ph function is estimated using data of the second period and found to be as follows:

$$Ph = \underset{(0.395)}{-0.306} + \underset{(0.368)}{1.550}\ PWB + \underset{(0.042)}{0.119}\ MX1 - \underset{(0.040)}{0.118}\ DR.MX1 \qquad (2,P2)$$

$$\bar{R}^2 = 0.921;\ D.W. = 2.695;\ \bar{\rho} = -0.493;\ SD - 0.152$$

$$LPh = \underset{(1.483)}{-1.550} + \underset{(0.238)}{0.283}\ LW + \underset{(0.346)}{0.964}\ LPWB \qquad (2.1,P2)$$

$$+ \underset{(0.018)}{0.077}\ MX1 - \underset{(0.019)}{0.085}\ DR.MX1$$

$$\bar{R}^2 = 0.943;\ D.W. - 2.891;\ \bar{\rho} = -0.556;\ SD = 0.064$$

The evidence of serial correlation in both equations is not conclusive. The proxy for cost push inflation (W) is omitted from the linear form equation (2,P2) because it is not only insignificant, but also it decreases the significance of the money index (MX1) variable to the level of 12.54 per cent. So its omission increases the significance of money variable to level 3.65 per cent and the significance of

(PWB) from 5.46 per cent level to 0.84 per cent level. This is in addition that the standard deviation of the estimated equation decreased from 0.166 to 0.152, and the corrected goodness of fit ($\bar{R}^2$) is increased from 0.906 to 0.921. The ratio of (MAE) to ($\bar{Y}$) is acceptable as it amounts to 4.35 per cent.

Now if the semi-log linear form equation is investigated, the proxy of cost push inflation is still insignificantly different from zero, but at least it is significant at level 30.0 per cent, and other independent variables are significant at the reasonable level. However in this respect if the nominal wage variable is omitted from the equation, the other variables including the intercept become highly significant at a level less than one per cent (see 2.11,P2), but the standard deviation is increased and the level of ($\bar{R}^2$) is decreased. The results are as follows:

$$LPh = \underset{(0.053)}{0.213} + \underset{(0.243)}{1.267}\ LPWB + \underset{(0.018)}{0.076}\ MX1 - \underset{(0.018)}{0.078}\ (DR.MX1) \qquad (2.11,P2)$$

$\bar{R}^2 = 0.938$; D.W. = 2.720; $\bar{\rho} = -0.446$; SD = 0.067

There is also no evidence of serial correlation in this equation.

The price elasticity of housing is also investigated, and it is found that the (Ph) elasticity with respect to (W) amounted to 0.442 in the linear form and 0.225 in the semi-log linear form in the whole period. But the difference between these elasticities is insignificantly different from zero. The (Ph) elasticity with respect to (PWB) is not statistically different from one in all periods. While the (Ph) elasticity with respect to (MX1) is not different from one in the second period and the whole period. It is lower than a half in the first period based on a statistical test, at the five per cent level. But this elasticity must be corrected by the elasticity of (DR.MX1) during the period (1970-77) to get the net elasticity in this period which is very small and negative.

TABLE XVI

PRICE ELASTICITY OF HOUSING WITH RESPECT TO (W), (PWB) AND (MX1)

Elasticity and Equation Form	First Period	Second Period	Whole Period
1) E(Ph,W)			
a) Linear form	N.S.	N.S.	0.442
b) Semi-log linear form	N.S.	0.283[2]	0.225
2) E(Ph,PWB)			
a) Linear form	3.648[1]	1.109	0.905
b) Semi-log linear form	4.392	0.964	1.062
3) E(Ph,MX1)[3]			
a) Linear form	0.248	0.830	0.537
b) Semi-log linear form	0.219	1.134	0.785

N.S. = not significant at all

[1]Significant at level 11.15 per cent

[2]Significant at level 30.00 per cent

[3]Those elasticities under second and whole periods are for 1969 and (1962-69) periods, respectively.

Money Supply

Following Friedman's analysis of money supply, the multiplier is considered as the fraction of money divided by the monetary base, the multiplier is given by the following identity:

$$Mi = \frac{\frac{CC}{Di} + 1}{\frac{CC}{Di} + \frac{R}{Di} + \frac{DC}{Di}} ; \qquad i = 1, 2;$$

where D1 = DD and D2 = TD = DD + TS.

The ratio (DC/Di) represents the private and semi government institution deposits held at the Central Bank; it is considered as exogenous while the other two fractions (CC/Di) and (R/Di) which represents the public and commercial banks behavior respectively, are considered as endogenous variables.

<u>The Currency-Deposit Ratio</u>

The best fit obtained for the ratio representing the public behavior is as follows:

$$\left(\frac{CC}{DD}\right)^* = \underset{(0.257)}{0.903} - \underset{(0.00016)}{0.00042}\ RYP + \underset{(6.597)}{26.056}\ rd2 - \underset{(0.322)}{0.977}\ (WS/YP) \qquad (3)$$

$\bar{R}^2 = 0.872$; D.W. = 1.551; $\rho_1 = 0.615$; SD = 0.088

$$L\left(\frac{CC}{DD}\right)^* = \underset{(0.934)}{4.463} - \underset{(0.094)}{0.333}\ LRYP + \underset{(0.189)}{0.834}\ Lrd2 - \underset{(0.188)}{0.561}\ L(WS/YP) \qquad (3.1)$$

$\bar{R}^2 = 0.886$; D.W. = 1.840; $\rho_1 = 0.616$; SD - 0.104

$$\left(\frac{CC}{TD}\right)^* = \underset{(0.224)}{0.767} - \underset{(0.00015)}{0.00024}\ RYP + \underset{(5.310)}{16.243}\ rd2 - \underset{(0.259)}{0.768}\ (WS/YP) \qquad (3.2)$$

$\bar{R}^2 = 0.715$; D.W. = 1.481; $\rho_1 = 0.696$; SD = 0.073

$$L\left(\frac{CC}{TD}\right)^{*} = \underset{(1.467)}{5.610} - \underset{(0.192)}{0.577}\ LRYP + \underset{(0.180)}{0.690}\ Lrd2 \qquad (3.21)$$

$$- \underset{(0.220)}{0.859}\ L(WS/YP)$$

$$\bar{R}^2 = 0.773;\ D.W. = 1.583;\ \rho_1 = 0.877;\ SD = 0.108$$

Where RYP is the real GDP in the non-oil sector, rd2 is the competitive price on total deposits, (WS/YP) is the ratio of wages and salaries to GDP in the non-oil sector representing the degree of income distribution and L is added to the variable to indicate the log.

Here it is likely to note that the real GNP (RY) and the competitive price of demand deposits (rd1) were tried in place of (RYP) and (rd2), but it is found more appropriate to use (RYP) and (rd2) since a lower level of error and a higher level of significance are our aim in estimating each equation.

The above four equations are corrected for serial correlation. For the first time a lower level of ($\bar{R}^2$) is reported because multicollinearity which mostly contribute to raise (R^2) is absent or very small in these equations based on the fact that the correlation between independent variables is very small. Concerning the significance of the coefficients, all independent variables in both forms are significant, except the variable (RYP) in equation (3.2) which has a lower level of significance. Of interest is the fact that the signs of the competitive price of total deposits and the wage-income ratio are contrary to what has been expected. That is, the competitive price is found positively related to the currency-deposit ratio and the wage-income ratio is negatively related to it. With respect to the competitive price of total deposits, it can be interpreted as the competitive cost of supplying deposits by the commercial banks, since the commercial banks are prohibited to pay interest or to receive any charges on demand deposits. In fact the competitive price of total deposits during the study's period was decreasing from 2.95 per cent in 1962 to 1.89 per cent in 1972, then it changed its direction to increase until it reached 2.99 per cent in 1977. This rise in the competitive price may have partly arose from the government action that all its employees should have current accounts at commercial banks in order to receive their salaries in these accounts. It increases also the cost of holding deposits at banks in terms of wasting time (about one hour) when a deposit holder wants to cash a check.

With respect to the wage-income ratio, the negative sign may have arose from the above mentioned government action, since most of the amount of wages and salaries is paid by the government and government institutions. The wage-income ratio was in the range of 38.0 to 69.0 per cent and was increasing during the first period by a rate lower than that prevailing in the second period. The annual average of the wage-income ratio increased from 0.47 during the first period to 0.57 during the second period. An experiment was conducted using a dummy variable to capture the effect of the government action which must have a negative effect on the currency-deposit ratio. This dummy variable appears to be significant with a correct sign, but its inclusion made the variables (RYP) and (WS/YP) insignificantly different from zero, therefore it is likely to be omitted from the equation. The lagged dependent variable was also omitted; it was found to be insignificantly different from zero.

Concerning the mean absolute error-mean dependent ratio (MAE/$\bar{Y}$) the linear forms (3 and 3.2) gave a lower percentage error which was 7.59 per cent for equation (3) and 8.43 per cent for equation (3.2), corresponding to 27.98 per cent and 15.34 per cent for log linear forms 3.1 and 3.21 respectively. That is to say if the money narrowly defined (M1) is used, a lower percentage error is contributed by the currency-deposit ratio function. However the linear form seems more appropriate even if the percentage error is not plausible as it exceeds the 5 per cent level. Table XVII shows the elasticity of currency-deposit ratio with respect to independent variables and (MAE/$\bar{Y}$) ratio.

TABLE XVII

CURRENCY-DEPOSIT RATIO ELASTICITY WITH RESPECT TO INDEPENDENT VARIABLES

Dependent variable	RYP	rd2	(WS/YP)	MAE/$\bar{Y}$ %
Linear form				
$(\frac{CC}{DD})$	-0.250	0.836	-0.626	7.59
$(\frac{CC}{TD})$	-0.195	0.711	-0.671	8.43
Log-linear form				
$(\frac{CC}{DD})$	-0.333	0.834	-0.561	27.98
$(\frac{CC}{TD})$	-0.577	0.690	-0.859	15.34

Of interest is the fact that the currency-deposit ratio elasticity with respect to (rd2) is not statistically different from one, While the currency-deposit ratio elasticity with respect to $(\frac{WS}{YP})$ is not statistically different from one in the case of $(\frac{CC}{TD})$ and is not different from one half in the case of $(\frac{CC}{DD})$. This elasticity with respect to (RYP) is less than one half, but it is not statistically different from one half when the function is estimated in the log-linear form; and it is statistically different from one half when the function is linearly estimated.

When the period analysis is concerned, it is found that using real GNP (RY) rather than (RYP) during the first period is more appropriate, because a higher $\bar{R}^2$ and a lower (SD) and (MAE/$\bar{Y}$) are obtained. (rd2) is omitted because it is found insignificant at all. The currency-total deposits ratio is estimated and found that all independent variables are insignificantly different from zero. The results of estimating the currency demand deposit ratio are as follows:

$$\left(\frac{CC}{DD}\right)^{*} = \underset{(3.943)}{13.039} - \underset{(0.0001)}{0.0006}\,RY - \underset{(2.319)}{3.241}\,(WS/Y) \qquad (3,P1)$$

$$\bar{R}^2 = 0.789;\ D.W. = 2.958;\ \rho_1 = -0.717;\ SD = 0.060$$

$$L\left(\frac{CC}{DD}\right)^{*} = \underset{(0.816)}{-0.200} - \underset{(0.077)}{0.241}\,LRY - \underset{(0.870)}{1.262}\,L(WS/Y) \qquad (3.1,P1)$$

$$\bar{R}^2 = 0.688;\ D.W. = 2.672;\ \rho_1 = -0.619;\ SD = 0.067$$

Both equations are corrected for serial correlation and equation (3,P1) is superior to equation (3.1,P1) if the (MAE/$\bar{Y}$) is concerned.

But when the functions are estimated during the second period, better results are obtained.

$$\left(\frac{CC}{DD}\right) = \underset{(0.3136)}{0.627} - \underset{(0.00017)}{0.00029}\ RYP + \underset{(9.188)}{30.737}\ rd2 - \underset{(0.451)}{0.966}\ (WS/YP) \qquad (3,P2)$$

$\bar{R}^2 = 0.712$; D.W. = 1.052; SD = 0.092

$$L\left(\frac{CC}{DD}\right) = \underset{(1.471)}{4.614} - \underset{(0.116)}{0.260}\ LRYP + \underset{(0.247)}{1.014}\ Lrd2 \qquad (3.1,P2)$$

$$- \underset{(0.256)}{0.628}\ L(WS/YP)$$

$\bar{R}^2 = 0.775$; D.W. = 1.503; SD = 0.111

$$\left(\frac{CC}{TD}\right) = \underset{(0.278)}{0.561} - \underset{(0.00015)}{0.00026}\ RYP + \underset{(8.138)}{22.527}\ rd2 - \underset{(0.399)}{0.739}\ (WS/YP) \qquad (3.2,P2)$$

$\bar{R}^2 = 0.647$; D.W. = 0.811; SD = 0.081

$$L\left(\frac{CC}{TD}\right) = \underset{(1.692)}{4.097} - \underset{(0.134)}{0.285}\ LRYP + \underset{(0.285)}{0.879}\ Lrd2 - \underset{(0.295)}{0.589}\ LWY \qquad (3.21,P2)$$

$\bar{R}^2 = 0.688$; D.W. = 1.135; SD = 0.127

In general there is no conclusive evidence of serial correlation in the above four equations. But when they are corrected for serial correlation, worse results are obtained, and it is found that (ρ_1) in each equation is insignificantly different from zero, which suggests the absence of serial correlation. The log-linear forms of equations are superior to those of linear forms based on both the level of significance of independent variables and the level of $\bar{R}^2$, while the opposite is true if the comparison is based on the percentage error. That is, the linear forms of equations are superior to those of log-linear forms based on both the level of standard error and the level of percentage error ($MAE/\bar{Y}$) occurring in each equation. But within the linear forms themselves equation (3,P2) is more appropriate than that of (3.2,P2) based on both the level of $\bar{R}^2$ and the level of ($MAE/\bar{Y}$). The latter amounts to 7.8 per cent in equation (3,P2) and 8.4 per cent in equation (3.2,P2). While the corresponding percentage errors arose from equations (3.1,P2) and (3.21,P2) are 10.1 per cent and 11.0 per cent respectively. Concerning the level of significance, it is likely to note that (rd2) is highly significant in all equations and (WS/YP) is significant only in equation (3.1,P2), while other variables in each equation are only significant at a lower level ranging between 10-15 per cent. The elasticity of the currency-deposit ratio during the second period, with respect to (RYP) is less than one half, but it is not statistically different from one half, while the elasticity with respect to (rd2) and (WS/YP) are statistically not different from one. Thus these elasticities have the same characteristics of those estimated ones during the whole period. However the income elasticity during the first period is statistically different from one half.

The Reserve-Deposit Ratio

With respect to the reserve-deposits ratio, the best initial ordinary least squares estimates with annual data are as follows:

$$\left(\frac{R}{DD}\right) = \underset{(0.108)}{1.367} - \underset{(1.959)}{20.142}\ rd2 - \underset{(0.104)}{0.700}\left(\frac{DD}{TD}\right) + \underset{(0.00071)}{0.00097}\ AGR \qquad (4)$$

$\bar{R}^2 = 0.896$; D.W. = 1.601; SD = 0.024

$$L\left(\frac{R}{DD}\right) = -7.091 - 1.430\ Lrd2 - 2.019\ L\left(\frac{DD}{TD}\right) + 0.073\ LAGR \qquad (4.1)$$

(0.564) (0.150) (0.282) (0.021)

$\bar{R}^2 = 0.903$; D.W. - 1.480; SD = 0.075

$$\left(\frac{R}{TD}\right) = 0.810 - 15.657\ rd2 - 0.222\ \left(\frac{DD}{TD}\right) + 0.00084\ AGR \qquad (4.2)$$

(0.060) (1.083) (0.058) (0.00039)

$\bar{R}^2 = 0.947$; D.W. = 1.619; SD = 0.013

$$L\left(\frac{R}{TD}\right) = -7.091 - 1.430\ Lrd2 - 1.019\ L\left(\frac{DD}{TD}\right) + 0.073\ LAGR \qquad (4.21)$$

(0.564) (0.150) (0.282) (0.021)

$\bar{R}^2 = 0.908$; D.W. = 1.480; SD = 0.075

Where (R/DD) is the reserve-demand deposit ratio (R/TD) is the reserve-total deposits ratio, rd2 is the competitive price on total deposits, DD/TD is the ratio of demand deposits to total deposits, AGR is the moving average (three years) of changes in reserves (ΔR) and L is added to denote the log value.

According to the Durbin-Watson statistics there is no evidence for serial correlation in the above equations. It is likely to note that the average rate of legal reserve requirements (ALR) is insignificantly different from zero with a wrong negative sign in the linear form and a correct positive sign in the log-linear form; therefore, its omission is reasonable to improve the fit of the reserve-deposit ratio functions. However there was a doubt in its significance and its share to explain some of the variations of the reserve-deposit ratio, since the legal reserve requirement rate was raised only once in 1966, from

10 per cent to 15 per cent on demand deposits and from 5 per cent to 7.5 per cent on time and savings deposits. The lagged dependent variable is also found to be statistically insignificant, which means that the desired reserve-deposit ratio is adjusted during the same period. Then with respect to the significance of the included independent variables, it is interesting to note that the (rd2), which has been taken here as a proxy for the opportunity cost of holding reserves, is significant at a very high level with a correct negative sign. That is to say the reserve-deposit ratio responds to variations in the (rd2) so that there is a support here to the hypothesis that the money supply may have some relationship to the interest rate in general. But with respect to the $(\frac{DD}{TD})$ variable, it is at high level of significance in all equations. The correct sign (negative) of $(\frac{DD}{TD})$ ratio is obtained in the case of the reserve-demand deposit ratio function.[4] While a wrong sign (negative) is obtained in the case of the reserve-total deposit ratio function. It must be positive because the required reserve ratio for demand deposits is higher than it is for time and savings deposits. That is to say when a rise in demand deposits exceeds the rise in time and savings depsoits, the average percentage increase in required reserves exceeds the average percentage increase in total deposits, so that the reserve-total deposit ratio should increase. The average change in reserves (AGR) is also significant, and contributes so much to improve the goodness-of-fit of each

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[4]Here it is considered as negative because (R) also contains reserves of time and saving deposits, which we cannot separate. Thus an increase in time and savings deposits which lead to a decrease in the demand deposits-total deposits ratio, reserves must increase and hence the reserve-demand deposit ratio must increase.

equation.

The elasticities of the reserve-deposit ratio with respect to independent variables are shown in Table XVIII. Of interest is the fact that elasticity of the opportunity cost of holding reserves is greater than one. It is also statistically different from one. While with respect to the (DD/TD) ratio, the elasticity is doubled in absolute value when the (R/DD) ratio is considered, to reach 1.646 in the linear form and 2.019 in the log linear form, against 0.699 and 1.019 when the (R/TD) ratio is considered, in the mentioned forms respectively. Then the reserve-deposit ratio responds by a very low level of elasticity, to variations in the (AGR) in Libya.

TABLE XVIII

THE ELASTICITIES OF RESERVE-DEPOSIT RATIO WITH RESPECT TO INDEPENDENT VARIABLES AND THE PERCENTAGE ERROR OF THE EQUATION

Dependent variable and equation form	rd2	$(\frac{DD}{TD})$	AGR	MAE/$\bar{Y}$ %
Linear form				
$(\frac{R}{DD})$	-1.708	-1.646	0.037[1]	5.28
$(\frac{R}{TD})$	-1.778	-0.699	0.043	3.86
Log linear form				
$(\frac{R}{DD})$	-1.430	-2.019	0.073	4.22
$(\frac{R}{TD})$	-1.430	-1.019	0.073	3.44

[1]Not significant

Regarding the first period analysis, all independent variables are significant, except (ALR) which is insignificant in all equations and with a wrong negative sign when the function is estimated in log-linear form. But (AGR) variable is highly significant with a wrong negative sign when the function is estimated in its linear form, and not significant at all (with a correct sign) when the log linear form is considered.

The (DD/TD) variable is highly significant in all equations while (rd2) variable is only significant when the function is linearly estimated. The results of the estimates of the reserve-deposit ratio during the first period are as follows:

$$\left(\frac{R}{DD}\right) = \underset{(0.129)}{2.605} - \underset{(3.687)}{52.810}\ rd2 - \underset{(0.005)}{0.036}\ AGR - \underset{(0.051)}{1.055}\ \left(\frac{DD}{TD}\right) \qquad (4,P1)$$

$\bar{R}^2 = 0.987$; D.W. $= 1.842$; SD $= 0.009$

$$L\left(\frac{R}{DD}\right) = \underset{(3.976)}{-9.282} = \underset{(1.107)}{2.024}\ Lrd2 + \underset{(0.084)}{0.055}\ LAGR - \underset{(0.472)}{2.302}\ L\left(\frac{DD}{TD}\right) \qquad (4.1,P1)$$

$\bar{R}^2 = 0.786$; D.W. $= 1.812$; SD $= 0.117$

$$\left(\frac{R}{TD}\right) = \underset{(0.115)}{1.413} - \underset{(3.288)}{31.309}\ rd2 - \underset{(0.0047)}{0.0163}\ AGR - \underset{(0.045)}{0.410}\ \left(\frac{DD}{TD}\right) \qquad (4.2,P1)$$

$\bar{R}^2 = 0.972$; D.W. $= 2.760$; SD $= 0.008$

$$L\left(\frac{R}{TD}\right) = -9.282 - 2.024\ Lrd2 + 0.055\ LAGR \qquad (4.21,P1)$$
$$\qquad\qquad (3.976)\quad (1.107) \qquad\quad (0.084)$$

$$- 1.302\ L\left(\frac{DD}{TD}\right)$$
$$(0.472)$$

$\bar{R}^2 = 0.755$; D.W. = 1.812; SD = 0.117

The Durbin-Watson statistics indicate no conclusive evidence of serial correlation in equation (4.2,P1) and free of serial correlation in other equations. The estimates of the log linear form indicate that the reserve-deposit ratio elasticity is (-2.024) with respect to (rd2), and it is not statistically different from one. While this elasticity is very large in the linear equations, as it amounts to (-4.135) in equation (4,P1) and (-3.682) in equation (4.2,P1), but statistically speaking, they are not different from four. The $(\frac{DD}{TD})$ ratio elasticity amounted to (-2.008) and (-2.302) in the linear form and log-linear form of the reserve-demand deposit ratio function respectively. They are not statistically different from two. However this elasticity is not different from one when the reserve-total deposit ratio function is considered, as they amounted to (-1.172) in the linear form and (-1.302) in the log-linear form. The elasticity of (AGR) may be ignored since it is insignificant in the log-linear form and with a wrong sign in the linear form. In general, the reserve-deposit ratio elasticities with respect to the independent variables, which are derived from the log linear forms, have the same characteristics of the corresponding elasticities during the whole period, except (rd2) which has a unitary elasticity in this period compared to a greater than one elasticity in the whole period.

The linear form equations are superior to those of log-linear forms, as they have a higher level of goodness of fit ($\bar{R}^2$) and a lower level of percentage error (MAE/$\bar{Y}$). (MAE/$\bar{Y}$) amounted to 1.467 per cent in the linear (R/DD) function, and 1.864 per cent in the linear (R/TD) function, compared to 6.614 per cent and 4.786 per cent in the log-linear (R/DD) and (R/TD) functions respectively.

During the second period, the best fit of the reserve-deposit ratio is also obtained when the average rate of reserve requirement is omitted from the function. The best variable which explains most variations in the dependent variable is the proxy for the opportunity cost of holding reserves. The results of the estimates of the function during the second period are as follows:

$$\left(\frac{R}{DD}\right) = \underset{(0.198)}{1.294} - \underset{(1.624)}{17.468}\ rd2 + \underset{(0.0004)}{0.0013}\ AGR - \underset{(0.206)}{0.670}\left(\frac{DD}{TD}\right) \qquad (4,P2)$$

$\bar{R}^2 = 0.958$; D.W. = 2.102; SD = 0.014

$$L\left(\frac{R}{DD}\right) = \underset{(0.782)}{-6.724} - \underset{(0.184)}{1.341}\ Lrd2 + \underset{(0.025)}{0.057}\ LAGR \qquad (4.1,P2)$$

$$- \underset{(0.785)}{1.907}\ L\left(\frac{DD}{TD}\right)$$

$\bar{R}^2 = 0.917$; D.W. = 1.957; SD = 0.065

$$\left(\frac{R}{TD}\right) = \underset{(0.163)}{0.782} - \underset{(1.339)}{14.503}\ rd2 + \underset{(0.00036)}{0.0011}\ AGR - \underset{(0.170)}{0.231}\left(\frac{DD}{TD}\right) \qquad (4.2,P2)$$

$\bar{R}^2 = 0.967$; D.W. = 2.049; SD = 0.011

$$L\left(\frac{R}{TD}\right) = -6.724 - 1.341\ Lrd2 + 0.057\ LAGR \qquad (4.21,P2)$$

$$\qquad (0.782)\quad (0.184) \qquad (0.025)$$

$$- 0.907\ L\left(\frac{DD}{TD}\right)$$

$$(0.785)$$

$$\bar{R}^2 = 0.931;\ D.W. = 1.957;\ SD = 0.065$$

These equations are free of serial correlation as indicated by the Durbin-Watson statistic or the changes of sign of the error term. The (rd2) variable is highly significant in all equations, while the (DD/TD) variable is significant at a reasonable level only in the reserve-demand deposit ration function equations (4,P2, 4.1,P2). The latter variable is not significant in the reserve-total deposit ratio function. The (AGR) variable is also significant in all equations, while if the (ALR) variable is not omitted, then AGR and (DD/TD) variables lose their reasonable level of significance. But it must be noted that the (DD/TD) variable has a wrong sign in the reserve-total deposit ratio function.

With regard to the opportunity cost elasticity, it is statistically not different from one in the log-linear forms and different from one in the linear forms, while it is found statistically different from one in both forms when the whole period is considered. But the reserve-deposit ratio elasticity with respect to (AGR) and (DD/TD) have the same characteristics which are found when the whole period is considered.

The Supply of Output in the Oil Sector

As the prices of petroleum started obviously to increase in the 1970's, it is preferable to consider the export price of the output in the oil sector as an independent variable in order to capture the change in income derived from the price's increase. Therefore, the gross domestic product (OY) in this sector is a function of the quantity of crude oil produced (QX), the prices of oil exports in dollars (OPX), the exchange rate of dollars in domestic currency (ES), and the change in real credits (DRLP) to measure the availability of credits for those companies providing services for oil producer companies. The function is estimated in nominal terms as it is not affected by the domestic price level since the oil industry is capital intensive and the income share of labor is so small that it can be neglected. The estimates of this function are as follows:

$$\underset{(680.353)}{OY = 2711.75} + \underset{(0.0766)}{0.6675\ QX} - \underset{(655.648)}{3163.45\ ES} + \underset{(24.843)}{495.085\ OPX} \tag{5}$$

$$- \underset{(1.190)}{9.113\ DRLP}$$

$$\bar{R}^2 = 0.993;\ D.W. = 2.113;\ SD = 82.300$$

$$\underset{(0.388)}{LOY = -0.515} + \underset{(0.060)}{1.020\ LQX} + \underset{(0.119)}{0.894\ LOPX} - \underset{(1.211)}{2.335\ LES} \tag{5.1}$$

$$- \underset{(0.056)}{0.039\ LDRLP}$$

$$\bar{R}^2 = 0.987;\ D.W. = 2.195;\ SD = 0.116$$

Both equations show no conclusive evidence of serial correlation based on the D.W. statistic, but according to sign changes in errors they are free of serial correlations. All independent variables are statistically significant when the function is estimated in its linear form (5). While when it is estimated in its log-linear form, the proxy for the availability of credits becomes insignificantly different from zero, despite it is still with a correct negative sign. All other signs are correct as expected.

Despite the fact that all independent variables in the linear equation are significant, the log-linear equation is still superior if the percentage error ($MAE/\bar{Y}$) is concerned, as the latter amounted to one per cent compared to 4.54 per cent in the linear form.

An increase in the quantity of oil production or in the prices of oil exports leads to an increase in (OY). While a depreciation in the dollar value which reflects an appreciation in the domestic currency value against the dollar will lead to a reduction in the (OY). This is the main reason as stated by the OPEC members for increasing oil prices in the 1970's. The other reason is that the prices of capital goods needed for development in the oil producing countries, are increasing very fast while the oil prices were reduced in 1959 and 1960 and remained frozen since then, in absolute value, while the purchasing power of the oil revenue was decreasing. In this respect there is unsolved argument between oil producers and consumers. That is to say that the producers raise the oil prices as to compensate the reduction in the purchasing power of their oil revenue.[5] This

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[5]An experiment is conducted to test the hypothesis of oil producer countries, that is, the oil price is a function of the world price of capital goods and the exchange rate of the dollar since the payments for oil exports are in dollars. A dummy variable is added to correct the slope of the world price of capital goods with respect to oil prices starting from 1974, the year of the big increase in oil prices. The results of estimating this function during the period (1962-1977) are as follows:

reduction comes from two sources: (a) the devaluation of the dollar in 1971 and in 1973, and the continuous gradual depreciation of the dollar in the international money market; (b) the rising world inflation especially in the prices of capital goods. While the oil consumers (industrial countries) argued that the oil producer countries are responsible for the rising inflation during the 1970's.[6] However in the case of Libya in particular, its share of the world market which is estimated by the value of its total exports expressed as a percentage of total world exports, was less than one per cent during the 1970's, an average of 0.852 per cent during the period (1970-1977) compared to 0.619 per cent during the period (1962-1969). Thus this negligible share leads to the conclusion that Libya alone exercised no influence on the level of international prices.

$$LOPX = \underset{(0.035)}{0.038} - \underset{(0.328)}{0.282}\ LPK + \underset{(0.328)}{1.248}\ D.LPK - \underset{(0.171)}{4.619}\ LES$$

$$\bar{R}^2 = 0.982;\ D.W. = 2.404;\ \bar{\rho} = -0.221;\ SD = 0.098$$

It is found that the dummy variable multiplied by the price of capital goods, and the exchange rate of dollars are statistically significant at a very high level, while the slope of the price of capital goods before 1974, is insignificantly different from zero, and has a negative sign. This is expected since the prices of oil exports were constant up to 1970, while the prices of capital goods were gradually increasing by an average of 2.0 per cent during the same period of constant oil prices.

[6]The hypothesis of industrial countries is tested also, considering the world price of capital goods as a function of oil prices and the exchange rate of the dollar. A dummy variable is also added in order to show the effects of the big increase in oil prices starting from year 1974. The results of estimating this function during the period (1970-1977) are as follows:

$$LPK = \underset{(0.281)}{0.140} + \underset{(0.856)}{0.419}\ LOPX - \underset{(0.545)}{0.097}\ D*LOPX - \underset{(2.745)}{0.756}\ LES$$

$$\bar{R}^2 = 0.827;\ D.W. = 1.515;\ \bar{\rho} = 0.144;\ SD = 0.131$$

The regression indicates that all independent variables are insignificantly different from zero and the dummy variable has a negative sign which is contrary to the expected positive sign.

The elasticity of the output in the oil sector is unitary with respect to the quantity of oil production and less than unity (0.894) with respect to the price of oil exports. It is not statistically different from one. But the oil sector output elasticity with respect to the exchange rate is 2.335 which is significant at 10 per cent, and is not statistically different from one. While in the linear equation where it is significant at a higher level, the elasticity amounted to 2.680 and it is statistically different from one. The output elasticity with respect to the availability of credits amounted to only 0.198 when it shows a high level of significance in the linear equation.

Now considering the analysis during the two periods, it is found that the best fit may be obtained, when the function is estimated in its log-linear form during the first period, and in its linear form during the second period. The following estimates are obtained:

$$LOY = -0.450 + 1.043\ LQX - 19.260\ LES - 0.141\ LDRLP \qquad (5,P1)$$

$$(0.866)\ (0.215) \qquad (37.706) \qquad (0.309)$$

$$\bar{R}^2 = 0.952;\ D.W. = 2.015;\ \bar{\rho} = -0.452;\ SD = 0.141$$

$$OY = 2183.1 + 0.480\ QX - 2386.2\ ES + 498.6\ OPX - 9.391\ DRLP \quad (5,P2)$$

$$(1068.7)\ (0.594) \qquad (1522.9) \qquad (30.208) \qquad (2.096)$$

$$\bar{R}^2 = 0.990;\ D.W. = 2.137;\ \rho = -0.135;\ SD = 99.3$$

The oil price variable is omitted from equation (5,P1) of the first period as it is found insignificantly different from zero and its sign is negative which is contrary to the expected positive sign. In addition the inclusion of oil prices in equation (5,P1) makes the quantity of oil production variable insignificant. But after its omission the quantity of oil production becomes very significant at a higher level (1.7 per cent). The other two variables are still insignificantly different from zero, but they have the expected correct signs. However, it is expected that the oil price variable and the exchange rate variable are not significant during the first period since oil prices remained constant and the exchange rate of the dollar seems to be stable compared with that of the second period.

With respect to the second period, the oil price and the availability of credits variables are statistically significant at a higher level, while other independent variables are insignificantly different from zero, even if they have the correct expected signs. The exchange rate variable is significant only at a level of 21.5 per cent. This is as a result of that the dollar is taken as a key currency for the Libyan Dinar leading to the fact that the exchange rate of the dollar remained constant during the last four years of this period. The quantity of oil production was insignificant in the equation, because this period witnessed a gradual reduction in oil production from 1211.1 million barrels in 1970 to 540.1 million barrels in 1975, then it showed some increase during the last two years of this period to reach 707.3 million barrels in 1976 and 753.1 million barrels in 1977.

The output elasticities during the two periods do not differ so much when the independent variable is significant compared to the corresponding elasticity in the whole period. That is to say, the output elasticity with respect to the quantity of oil production amounted to 1.043 during the first period while this elasticity is insignificant during the second period and amounted to 0.881, but it is not statistically different from one. The output elasticity with respect to (DRLP) accounted for (-0.195) in the second period, while those of oil production and the exchange rate are ignored since they are insignificantly different from zero.

The Supply of Output in the Non-Oil Sector

The supply function of output which was derived in Chapter IV is estimated in both forms linear and log-linear as follows:

$$RYP^{*} = \underset{(777.702)}{1899.59} + \underset{(0.125)}{0.628}\, RW - \underset{(75.946)}{43.191} \left(\frac{PK}{P}\right) - \underset{(732.46)}{1839.64}\, E \qquad (6)$$

$$+ \underset{(0.517)}{1.392}\, DRLP + \underset{(0.177)}{0.149}\, RYP1$$

$$\bar{R}^2 = 0.984;\ h = -2.722;\ \rho_1 = -0.551;\ SD = 40.126$$

$$LRYP = \underset{(0.192)}{0.562} + \underset{(0.074)}{0.582}\, LRW - \underset{(0.094)}{0.466}\, L\left(\frac{PK}{P}\right) - \underset{(0.461)}{1.758}\, LE \qquad (6.1)$$

$$+ \underset{(0.036)}{0.132}\, LDRLP + \underset{(0.123)}{0.255}\, LRYP1$$

$$\bar{R}^2 = 0.985;\ h = -1.965;\ SD = 0.083$$

In equation (6), the star on the dependent variable means that the regression is corrected for serial correlation while the regression (6.1) is free of serial correlation based on the Durbin h-statistic. A glance to these two equations, it is obvious that equation (6.1) is superior to that of (6) as all independent variables in equation (6.1) are statistically significant at a higher plausible level. While in equation (6) (linear form) there are two variables, $(\frac{PK}{P})$ and (RYP1) insignificantly different from zero. In addition the $(MAE/\bar{Y})$ percentage ratio amounts to only less than one per cent compared to about 4.131

per cent in equation (6). Thus equation (6.1) is likely to be considered in the complete model. Now it must be noted that a positive relationship is obtained between the supply of output and the real wage, which is contrary to the theoretical view. However, if the real output is regressed on changes in (RW) and (PWK/P) rather than the absolute ratios, the negative sign for both variables are obtained, but they are not significant at all, despite the other two variables (DRLP and RYP1) are still at a higher level of significance. Therefore such estimates are ignored, since they are inferior compared to that of equation (6.1), even the coefficient of (RW) variable has the correct negative sign. That is when real wage increases, employers reduce the number of workers and hence the supply of output decreases, other things being constant, or if the industry can move to more capital intensive, then the income of labor group declines and the income of capital owners will rise. Doubtless to say that in the case of Libya most industries (small and medium) (in the non-oil sector) are labor intensive[7], and the possibility of moving gradually to more capital

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[7]Assuming the production function in Libya as a function of labor and the level of imports of capital goods, the following results are obtained:

$$LRYP^{*} = 4.565 + \underset{(1.015)}{0.936}\ LL + \underset{(0.608)\quad(0.154)}{0.473\ LRMKP}$$

$$\bar{R}^2 = 0.765;\ D.W. = 2.048;\ \rho_1 = 0.611;\ SD = 0.144$$

This regression is corrected for serial correlation and the capital proxy coefficient is very significant at a high level (1 per cent), while the coefficient of labor is significant at a lower level (15 per cent). However, if the function is linearly estimated the coefficient of labor becomes very significant at a higher level while that of capital proxy is significant only at level (16 per cent), and the output elasticity with respect to labor is 2.2 while that of capital proxy is (0.2). Thus in both estimates (log-linear and linear) the output elasticity with respect to labor exceeds by two times or more the output elasticity of the capital proxy. This is a support that most productive units in Libya is labor intensive.

intensive in the same existing industries cannot be ignored especially in the agricultural sector where the development of using mechanization is obvious during the last decade. As more capital is introduced in an industry the productivity of labor increases also.

The per capita capital imported augmented for each worker increased from LD. 65.4 in 1962 to LD. 121.2 in 1969 and L.D. 330.6 in 1977, an annual average of LD. 185.0 during the whole period. The average annual growth of total imports of capital and intermediate goods amounted to 27.7 per cent during the whole period (1962-1977). Thus it is reasonable to assume that productivity of labor is increased also because of the mentioned capital addition,[8] and hence an equal rise in the real wage is expected if there is a situation of competition. However it is widely felt that the employer is not giving a real wage equal to productivity of the worker. This feeling persuaded the government to raise the minimum wage about four times during the period under discussion.

The minimum wage comes mostly in favor of those marginal workers

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[8] When a time trend variable (T) is added to the production function as proxy for labor productivity, the new variable is highly significant in both linear and log linear forms, but it tends to decrease the significance of (L) and (RMKP) in the log linear form and the coefficient of (L) is with a wrong sign. Thus it is ignored. While when the function is linearly estimated all independent variables become significant as follows:

$$\underset{}{RYP} = \underset{(174.46)}{-411.97} + \underset{(495.91)}{1164.16}\,L + \underset{(0.431)}{0.865}\,RMKP + \underset{(8.705)}{21.045}\,T$$

$$\bar{R}^2 = 0.973;\ D.W. = 1.861;\ SD = 53.497$$

This regression is free of serial correlation. The output elasticities with respect to (L), (RMKP) and (T) are 1.291, 0.211 and 0.377 respectively. The output elasticity of labor is not statistically different from one. The improvement in productivity comes from the augmented capital goods used by workers and from increases in the skill experience and health of workers (99, p. 5).

in the government institutions, as it is widely known that the worker's wage in the private sector exceeds the announced minimum wage, except some rare cases such as the marginal workers whose efficiencies are very weak or those imported labor from neighbor countries by the private sector. But the skillful labor was not affected by the minimum wage, as they were subject to a lower level of competition between a limited number of factories. In addition most Libyan workers do not like to change employers on the base of wage difference especially if this difference is very small. Thus it is reasonable to expect that Libyan workers outside the government sector is underpaid if compared to his productivity.[9]

But the trend of growth rate of productivity does not support the hypothesis that workers receive a real wage lower than their productivities. The average rate of growth in productivity of labor amounted to 11.94 per cent per year during the period, which is lower than that of real wages (15.18 per cent). However if that hypothesis may be acceptable in the private sector, it is not true in the government sector. But in the economy as a whole the hypothesis is not valid.

As equation (6.1) is in a log-linear form, the coefficients of independent variables are the short run elasticities of real output with respect to the corresponding independent variables since the equation is a dynamic one. That is one percentage increase in the real wage will lead in the short run to a percentage increase of 0.582 in real output, while one percentage increase in the (PK/P) ratio will

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[9]The concept of productivity is (in this study) as the ratio of real output to labor input. In general, the term productivity is a measure of the relationship between production of goods and services and one or more of the factors of production (110, p. 13).

lead to (0.466) percentage decrease in real output owing to the fact that an increase in this ratio will lead to decrease imports of capital goods, and the latter will lead to a decrease in real output. The same thing is true with respect to the exchange rate, since the exchange rate is positively related to the price of imports of capital goods, and hence it is negatively related to the real output. That is an increase in the exchange rate leads to increase the price of imports of capital goods, and the latter tends to decrease such imports and hence the real output. However when the long run elasticity is concerned, it is greater by about 55 per cent as the coefficient of adjustment is equal to 0.645. As the exchange rate gained a high level of elasticity (2.73) it becomes an important policy instrument in this respect. That is one percentage decrease in the exchange rate which is in the hands of the Central Bank will lead to 2.73 percentage increase in real output. While the proxy for unutilized capacity (DRLP) is less important than other independent variables, as its elasticity with respect to output is only 0.205. That is a percentage increase in (DRLP) given to the economy will lead to a percentage increase of only (0.205) in output.

The long run output elasticity with respect to (RW) and the (PK/P) ratio are (0.90) and (-0.72) respectively. The former is positive because the coefficient of (RW) has a wrong sign.

Now concerning the analysis by period, the behavior of the supply function of output is investigated and it is found that the best fit can be obtained when this function is log-linearly estimated during both periods. The proxy for unutilized capacity is omitted from the equation during the first period as it is found that this proxy has a high rate of correlation with other independent variables (from 0.90 to 0.95) in order to avoid the severe existence of multicollinearity.

The lagged dependent variable is also omitted for the same reason as its rate of correlation (0.988) with the price ratio variable $(\frac{PK}{P})$ exceeds the multiple rate of correlation of the equation. While the exchange rate is omitted because it is not significant at all on one hand, and it has a wrong sign on the other. In addition the omission of the exchange rate variable leads to make the price ratio variable a significant one at the reasonable level. Thus the results of the estimates of this equation during the first period are as follows:

$$LRYP = \underset{(1.119)}{1.366} + \underset{(0.221)}{0.690}\ LRW - \underset{(0.544)}{1.476}\ L(\frac{PK}{P}) \qquad (6.1,P1)$$

$$\bar{R}^2 = 0.967;\ D.W. = 2.729;\ \bar{\rho} = -0.510;\ SD = 0.082$$

Both independent variables are significant and have the same directions of signs that obtained for the whole period. That is, the real wage is positively related to the output which is contrary to the theoretical view, while the sign of the price ratio is correct as it is negatively related to the supply of output.

But when changes in real wage, price ratio and the exchange rate are considered instead of their absolute values, a better results are obtained as follows:

$$LRYP = \underset{(0.95)}{4.256} - \underset{(0.0017)}{0.005}\ (\frac{\Delta LW}{\Delta LP}) - \underset{(0.004)}{0.031}\ (\frac{\Delta LPK}{\Delta LP}) \qquad (6.11,P1)$$

$$- \underset{(13.433)}{39.384}\ \Delta LE + \underset{(0.073)}{0.711}\ LDRLP$$

$$\bar{R}^2 = 0.990;\ D.W. = 1.754;\ \bar{\rho} = 0.058;\ SD = 0.042$$

That is, the price ratio variable and the proxy for unutilized capacity variable are highly significant, while the real wage and the exchange rate variables are significant at a lower level (10%). Therefore it is preferable to consider this equation as it is superior to equation (6.11,P1) especially the (MAE/$\bar{Y}$) is only 0.31 per cent compared to 1.0 per cent in equation (6.11,P1).

But with respect to the second period, the lagged dependent variable is omitted from the equation as it is found insignificantly different from zero, that is, the desired output is fully adjusted during the same year. Then the equation with the remaining independent variables is estimated and the following results are obtained:

$$\underset{}{LRYP} = \underset{(1.415)}{5.316} + \underset{(0.224)}{0.123}\ LRW + \underset{(0.446)}{1.161}\ L\left(\frac{PK}{P}\right) - \underset{(0.697)}{1.781}\ LE \qquad (6.1,P2)$$

$$+ \underset{(0.036)}{0.081}\ LDRLP$$

$$\bar{R}^2 = 0.988;\ D.W. = 3.091;\ \bar{\rho} = -0.670;\ SD = 0.049$$

There is no conclusive evidence of serial correlation in this equation based on D.W. statistics, but if the change of signs in the residual item is considered the above both equations (6.1,P1 and 6.1,P2) are free of serial correlation as such a sign changed five times among eight observations. In equation (6.1,P2) real wage is not significant at all, while the price ratio variable and the exchange rate variable are significant at a lower level, an eight per cent. The proxy for unutilized capacity is significant only at a level of eleven per cent. However if the exchange rate is included in the prices of imports and changes in real wage and price ratio are considered instead of their absolute values, the following results are obtained:

$$LRYP = \underset{(1.612)}{1.044} - \underset{(0.013)}{0.017}\left(\frac{\Delta LW}{\Delta LP}\right) - \underset{(0.007)}{0.007}\left(\frac{\Delta LPWK}{\Delta LP}\right) \qquad (6.11,P2)$$

$$+ \underset{(0.056)}{0.161}\ LDRLP + \underset{(0.266)}{0.775}\ LRYP1$$

$$\bar{R}^2 = 0.876;\ h = -0.275;\ SD = 0.156$$

The regression is free of serial correlation, and all independent variables have the correct signs. But the real wage variable and the price ratio variable are not significant at any reasonable level, while the other two variables are significant at level 6.3 per cent. However despite equation (6.11,P2) has a lower $\bar{R}^2$, a higher SD and a little bit higher $(MAE/\bar{Y})$, compared to equation (6.1,P2) the former equation is still more appropriate since it is associated with the theoretical view on one hand, and it has a relative higher level of significance for some variables on the other.

But it is interesting to note that the ratio of the absolute mean error to the dependent variable mean is only 0.31 per cent in equation (6.11,P1) and 1.1 per cent in equation (6.11,P2), compared to 0.8 per cent in the log-linear equation (6.1) of the whole period. Thus it is likely to note that equation (6.11,P2) is preferable if forward fore-casting is needed, and (6.11,P1) is preferable if backward forecasting is needed.

Demand for Imports of Capital Goods

The demand function for imports of capital goods and intermediate goods (RMKP) is estimated in both forms (linear and log linear), but it is found that the log-linear form is more appropriate, based on (MAE/$\bar{Y}$) which amounts to 11.7 per cent in the linear equation despite all independent variables are significant. The lagged dependent variable is omitted as it is found insignificantly different from zero.

$$RMKP^{*} = \underset{(446.62)}{2295.86} + \underset{(0.078)}{0.761}\ RYP - \underset{(0.048)}{0.274}\left(\frac{W}{PK}\right) + \underset{(435.22)}{2253.44}\ E \tag{7}$$

$$- \underset{(23.855}{50.307}\ E.DE + \underset{(0.297)}{0.683}\ DRM2$$

$\bar{R}^2 = 0.950$; D.W. = 2.922; $\rho_1 = -0.739$; SD = 21.938

$$LRMKP = \underset{(1.023)}{-2.013} + \underset{(0.424)}{1.644}\ LRYP - \underset{(0.531)}{0.483}\ L\left(\frac{W}{PK}\right) + \underset{(6.134)}{13.824}\ LE \tag{7.1}$$

$$- \underset{(6.666)}{13.119}\ (LE*DE) - \underset{(0.106)}{0.110}\ LDRM2$$

$\bar{R}^2 = 0.951$; D.W. = 2.061; SD = 0.188

Where RYP is the real GDP in the non-oil sector, $\left(\frac{W}{PK}\right)$ is the ratio of wage to the foreign price of imports of capital goods, E is the exchange rate in terms of home currency, DE is dummy variable to capture the effect of changes in the exchange rate arising from devaluation and floating of the key foreign currencies, it equals to one for years greater than 1970 and zero otherwise.

DRM2 is the change in real money balances broadly defined, as a proxy for the unutilized capacity in the units of production, and L is added to the variable to denote log.

There is no evidence of serial correlation in equation (7.1), while equation (7) is corrected for serial correlation. (RYP) has the highest level of significance in both equations. But both regressions show a wrong sign with respect to both variables $(\frac{W}{PK})$ and (E). The estimated coefficient of $(\frac{W}{PK})$ is not significant, while that of (E) is significant in equation (7.1). The ratio of $(\frac{W}{PK})$ must be positively related to the demand for (RMKP). An increase in wages or a decrease in prices of capital goods must lead to a rise in demand for (RMKP). While the (E) variable must be negatively related to the demand for (RMKP). A decrease in (E) must lead to decrease the foreign prices of capital goods (PK), and the latter must lead to an increase in demand for (RMKP). The variable (DE.LE) has the right sign and it is significant at level 10.0 per cent in equation (7.1). But if such a variable is omitted, the exchange rate would have an insignificant coefficient with a wrong sign (positive). The proxy variable for the unutilized capacity appeared to be insignificant (it is significant in the linear equation), but with a right sign (negative).

The elasticity of (RMKP) is 1.644 with respect to (RYP). That is to say the demand for (RMKP) is elastic with respect to (RYP), despite it is statistically not different from one. But of interest, is the fact that the Libyan importers are not sensitive to the prices of imported capital goods, and they do not also observe the changes in the exchange rate, while such changes are observed by the foreign exporters of capital goods to Libya, as it is suggested by the positive sign of the foreign exchange rate. The foreign exporters observe also the foreign price level of capital goods. That is to say, it is almost a supply function rather than a demand function for real imports of capital goods. This may be the case, because most imports of capital goods are imported by foreign contractors who are doing business with the government and government institutions for those development projects, especially industrial projects, given to them. While the other part of capital goods which is really marketed in Libya, is reasonable to be expected as sensitive to the domestic price level changes. When the $(\frac{W}{PK})$ ratio is lagged one period, regression (7) is improved in terms of higher $\bar{R}^2$ and lower (MAE/$\bar{Y}$). That is, (MAE/$\bar{Y}$) amounts to 2.60 per cent in equation (7.11) compared to 2.72 per cent in equation (7.1). Thus equation (7.11) is preferable to be included in the complete model.

$$\underset{}{LRMKP} = \underset{(0.693)}{-2.511} + \underset{(0.333)}{1.788}\ LRYP - \underset{(0.323)}{0.533}\ L(\frac{W}{PK})_{-1} \qquad (7.11)$$

$$+ \underset{(4.939)}{14.616}\ LE - \underset{(4.900)}{13.437}\ (DE.LE) - \underset{(0.077)}{0.138}\ LDRM2$$

$$\bar{R}^2 = 0.959;\ D.W. = 2.335;\ SD = 0.170$$

In equation (7.11), $(\frac{W}{PK})$ and (E) variables are still with a wrong sign. The regression shows no evidence that the serial correlation exists. The coefficients of the variables $(\frac{W}{PK})$ and (DRM2) are significant at level 15 per cent. While other independent variables show a high level of significance, 2.0 per cent or less. An experiment is also done on replacing $(\frac{W}{PK})$ and (E) by their changes, giving the initial following estimates:

$$LRMKP = -4.196 + 1.457\ LRYP + 0.030\ (\frac{\Delta LW}{\Delta LPK}) \quad (7.12)$$

$$(0.760)\ (0.153)\qquad (0.0115)$$

$$-\ 0.271\ \Delta LE - 0.075\ LDRM2$$

$$(2.207)\qquad (0.110)$$

$\bar{R}^2 = 0.930$; D.W. = 1.247; $\bar{\rho}_1 = 0.350$; SD = 0.225

All independent variables have the correct signs, but (ΔLE) and (LDRM2) are not significant at all, while (RYP) and ($\frac{W}{PK}$) are highly significant. The ratio of (MAE) to ($\bar{Y}$) is higher compared with that of equation (7.11) amounting to 3.69 per cent. However, it is still felt that equation (7.11) is superior to equation (7.12).

Now concerning the period analysis of the above behavioral equation, it is found that the best fit can be obtained during the first period and is as follows:

$$LRMKP = -1.094 + 0.033\ LRYP + 0.843\ L(\frac{W}{PK}) + 11.426\ LE \quad (7.1,P1)$$

$$(0.928)\ (0.549)\qquad (0.505)\qquad (6.740)$$

$\bar{R}^2 = 0.884$; D.W. = 2.815; $\bar{\rho} = -0.443$; SD = 0.109

(DRM2) is omitted for two reasons: 1) it is insignificant at all, 2) when it is included, the coefficient of (RYP) becomes negative which is contrary to the theoretical view. But even with these three independent variables, they are insignificant at 5 per cent level, and the exchange rate is still with a wrong sign. While the ratio of wages to foreign prices of capital goods has the correct sign (positive) which is associated with the theoretical view. However it is likely to note that the variable ($\frac{W}{PK}$) is significant at 17.0 per cent level, and the exchange rate is significant at 16.5 per cent level. While the income proxy is not significant at all.[10]

Concerning the second period, the best fit can be obtained with our original independent variables is as follows:

$$LRMKP = \underset{(3.046)}{-8.597} + \underset{(0.340)}{1.634}\ LRYP + \underset{(0.656)}{0.310}\ L(\frac{W}{PK}) \qquad (7.1,P2)$$

$$+ \underset{(1.509)}{5.205}\ LE + \underset{(0.174)}{0.280}\ LRMKP1$$

$$\bar{R}^2 = 0.972;\ h = -0.010;\ SD = 0.126$$

(DRM2) is omitted for three reasons: (a) it is not significant; (b) it has a wrong sign; (c) when it is included, the $(\frac{W}{PK})$ variable becomes negatively related to demand for (RMKP). But the $(\frac{W}{PK})$ ratio is still not significant even if it has the correct sign.[11] This is reasonable to be expected, since the public sector is dominating investment in every economic field, especially in the industrial sector where large and medium industries must be owned by government institutions (industrial law). Since the public sector's main national goal is to reach self-sufficiency in necessary commodities, the attention given to the economic cost-benefit analysis is secondary. Thus the capital goods become as a giffen good in this respect as it is shown by the estimates of the whole period.

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[10] When changes in $(\frac{W}{PK})$ and (E) are considered in the first period, the direction of correct signs are obtained. But the level of significance is still not plausible. The coefficients of (RYP), $(\frac{W}{PK})$ and (E) are significant at lower levels; 5.84 per cent, 30.0 per cent and 36.5 per cent respectively.

[11] When changes in $(\frac{W}{PK})$ and (E) variables are considered in the second period, the direction of correct signs are obtained, but they are not significant at all.

Now concerning elasticity of demand for (RMKP), it amounts to 1.788 with respect to (RYP) during the whole period compared to 1.634 during the second period, the latter is not different from one while the former is different from one. The demand elasticity with respect to $(\frac{W}{PK})$ ratio is not significant during all periods, amounting to less than one, and it is not different from one. But the demand elasticity with respect to exchange rate (even with a wrong sign) is very high during the first period (11.4) compared to (5.2) during the second period. However, it amounts to 14.6 during the period 1963-1970, and then corrected to reach only (1.2) during the rest of the period (1971-1977).

Demand for Imports of Consumer Goods

It is assumed that demand function for real imports of consumer goods (RMC) is determined by the following independent variables: real gross national product (RY), foreign price of imports of consumer goods domestic price ratio $(\frac{PMC}{P})$, the exchange rate (E), the tax rate on imports of consumer goods as a ratio (Tr = TX/Mc) and a lagged dependent variable (RMC1). This function is estimated in both forms (linear and log linear) and the following results are obtained:

$$\underset{}{RMC} = \underset{(102.355)}{-558.785} + \underset{(0.013)}{0.088}\ RY + \underset{(16.404)}{107.986}\ (\frac{PMC}{P}) + \underset{(99.459)}{520.105}\ E \qquad (8)$$

$$- \underset{(5.224)}{13.454}\ (E*DE) - \underset{(32.385)}{149.005}\ Tr + \underset{(0.077)}{0.430}\ RMC1$$

$\bar{R}^2 = 0.997;\ h = -1.416;\ SD = 4.465$

$$LRMC = -0.477 + 0.342\ LRY + 0.835\ L(\frac{PMC}{P}) + 1.402\ LE \qquad (8.1)$$
$$(0.311)\ (0.134) \qquad (0.165) \qquad (1.865)$$

$$- 0.819\ (LE*DE) - 0.524\ LTr + 0.517\ LRMC1$$
$$(1.906) \qquad (0.127) \qquad (0.129)$$

$\bar{R}^2 = 0.996$; $h = -0.746$; $SD = 0.046$

Both equations are free of serial correlation based on the Durbin-h test. In the linear form (equation (8)) all independent variables are significant, but the price ratio variable and the exchange rate variable have the wrong signs.[12] An increase in the foreign price level or a decrease in domestic price level leads to a decrease in imports of consumer goods. The exchange rate must also be negatively related to the real imports of consumer goods, because the exchange rate has a positive effect on foreign prices of imports. That is an increase in the exchange rate in terms of home currency leads to increase the foreign price level and the latter is negatively related to demand for real imports, thus imports must decrease as a result of the increase in the value of the exchange rate. So this function is facing the same problem as that faced by the demand function for real imports of capital goods. In fact a big part of imports of consumer goods is the food stuffs most of which is imported by the National Food Supply Corporation, established in 1971. This Corporation does not do business on economic marketing bases as long as it received a big amount of subsidy from the government to cover the difference

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[12]When $(\frac{PMC}{P})$ and (E) are replaced by their changes, the change in price ratio has the correct sign but not significant at all, the change in foreign exchange is still with a wrong sign, Tr has a wrong sign, and they are insignificant at all.

between the domestic price and the world price. This policy leads to increase imports of subsidized commodities since their prices are about to be constant, while income and prices of other commodities are increasing continuously. Thus such behavior may lead to abolish the corporation's sensitivity to foreign prices of the subsidized commodities, especially when its main objective is to make those necessary commodities available in the Libyan market. However, when the ratio of prices is broken down into foreign price level and domestic price level, and the above function reestimated, the coefficient of foreign price has a positive sign, while the coefficient of domestic price level has a negative sign, leading to the conclusion that some importers observe the domestic price when they make such imports. The reestimates of the demand function for (RMC) are the following:

$$\begin{aligned} RMC = {} & -382.349 + 0.062\ RY + 85.454\ PMC - 45.428\ P \qquad (8.2) \\ & \quad (89.431) \quad (0.015) \qquad (13.511) \qquad (15.241) \\ & + 412.827\ E - 6.899\ (E.DE) - 136.435\ Tr + 0.359\ RMC1 \\ & \quad (93.259) \qquad (4.141) \qquad (26.444) \qquad (0.088) \end{aligned}$$

$$\bar{R}^2 = 0.998;\ \rho = 0.041;\ h = 0.169;\ SD = 3.533$$

This equation shows that all independent variables are significant at a higher level, except that variable representing the effect of foreign currencies devaluations and exchange rate floating (DE*E) which is significant at a lower level, a 14.0 per cent. The coefficient of this variable is correct to be negative since the devaluation of the dollar and depreciations of other currencies leads to show that the foreign exchange of foreign currencies in domestic currency is lower, and hence foreign prices are lower too; therefore demand for imports must increase. The average tariff rate has the correct sign (negative), since an increase in the tariff rate leads to increase the average price of imports and the latter cause a decrease in demand for imports.

The long run elasticity of demand for (RMC) from equation (8.1), is 0.708 with respect to real GNP, and it is not different from one. The other demand elasticities are 1.729 with respect to $(\frac{PMC}{P})$, 2.903 with respect to exchange rate and -1.085 with respect to (Tr). However, equation (8.1) is appropriate, even though it has an insignificant coefficient of the exchange rate, based on that $(MAE/\bar{Y})$ is less than one per cent, while this percentage error is over 2.41 per cent in the linear form.

When the function is investigated during the first period, it is found that the log-linear form is more appropriate. The results are as follows:

$$LRMC^{*} = \underset{(0.493)}{3.918} + \underset{(0.012)}{0.469}\ LRY - \underset{(0.048)}{0.296}\ L(\frac{PMC}{P}) \qquad (8.1,P1)$$

$$+ \underset{(0.249)}{0.471}\ LE - \underset{(0.023)}{0.568}\ LTr$$

$$\bar{R}^2 = 0.9999; D.W. = 3.663; \rho_1 = -0.791; SD = 0.006$$

This regression is corrected for serial correlation and this correction obtains better results,[13] except that the exchange rate variable continued to be insignificant and with a wrong sign despite

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[13]Despite it is still showing serial correlation based on D.W. statistics the author is satisfied by the correction of the first degree only.

it had the correct sign before the correction of serial correlation. While other independent variables are highly significant and have the correct signs. Thus it seems that during the first period in which the private sector is dominating, the economic behavior of the society is associated with the theoretical economic view. The lagged dependent variable is omitted as found insignificant, and hence the demand for desired imports of consumer goods is adjusted during the same period.

But with respect to the second period, it is found that the demand function for real imports of consumer goods may give a satisfactory result whether it is estimated in its linear form or in its log linear form. They are as follows:

$$\underset{}{RMC} = \underset{(27.159)}{-558.288} + \underset{(0.004)}{0.081}\, RY + \underset{(8.073)}{119.994}\left(\frac{PMC}{P}\right) + \underset{(29.779)}{522.838}\, E \qquad (8,P2)$$

$$- \underset{(1.723)}{12.282}\,(E.DE) - \underset{(20.587)}{187.322}\, Tr + \underset{(0.023)}{0.477}\, RMC1$$

$$\bar{R}^2 = 0.9998;\ h = -1.071;\ SD = 1.070$$

$$LRMC = \underset{(0.341)}{-2.040} + \underset{(0.040)}{0.628}\, LRY + \underset{(0.082)}{0.634}\, L\left(\frac{PMC}{P}\right) \qquad (8.1,P2)$$

$$+ \underset{(0.165)}{1.731}\, LE - \underset{(0.044)}{0.428}\, LTr + \underset{(0.026)}{0.447}\, LRMC1$$

$$\bar{R}^2 = 0.9998;\ h = -1.886;\ SD = 0.007$$

Both equations are free of serial correlations based on Durbin-h test. All independent variables in both equations are highly significant except two variables in equation (8,P2) (DE.E)[14] and (Tr) which are significant at a lower level; 9.0 per cent and 7.0 per cent respectively. But the price ratio and foreign exchange variables have wrong signs. This is explained as before, by that government is subsidizing the main necessary food stuffs. In addition demand for any commodity exceeds its supply, so that importers do not pay any attention to the foreign prices as far as the domestic price can be raised to the profitable level. Since this direction of signs also occurred in the whole period, it is therefore obvious that the economic activities during the second period have a higher influence on the behavioral equation during the whole period.

As the adjustment coefficient equals 0.553 in equation (8.1,P2), the long run elasticities of demand for (RMC) during the second period are 1.136 with respect to (RY), 1.146 with respect to $(\frac{PMC}{P})$, 3.130 with respect to (E) and -0.774 with respect to the (Tr). The income elasticity and the price ratio elasticity are statistically not different from one, while the demand elasticity during the first period was only 0.469 and 0.296 with respect to income and price ratio respectively. Demand elasticities with respect to (E) and (Tr) are also lower during the first period, amounting to 0.471 and 0.568 respectively. Of interest is the fact that the differences between the corresponding elasticities in both periods are very significant, which suggest that the economic behaviors of Libyan people are also different in these two periods.

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[14]This variable is omitted from equation (8.1,P2) because it is not signfiicant at any level.

Estimating the (BOP) Reduced Form

The reduced form of the equations system of the balance of payments, explained in Chapter IV, is:

$$\left(\frac{NFA}{H}\right) GNFA = \alpha 1GRY - \alpha 2GRM + \alpha 3GRS + GP - Gmu - \left(\frac{D}{H}\right) GD + e' \qquad (9)$$

where e is a stochastic disturbance term and the multiplier (mu) summarizes the behaviors of both the commercial banks and the public, NFA denotes the net foreign assets, H denotes the monetary base, RY denotes real GNP, RM denotes the opportunity cost of holding money, RS is the rental price of money substitutes, P is the domestic price level, D is net domestic assets, or the credit creation, and G is added to the variable to denote the rate of growth.

The coefficients of last three variables, namely GP, Gm, and $(\frac{D}{H})$GD are considered to take the hypothesized values of (+ 1.0) for GP, (-1.0) for both Gmu and $(\frac{D}{H})$GD. However if the error term is equal to zero the above hypothesized values would be precisely hold. But if the assumption of fixed exchange rate is relaxed, that is to introduce an exchange rate (E) that can be changed, then the above equation becomes:

$$\left(\frac{NFA}{H}\right) GNFA = \alpha 1GRY - \alpha 2GRM + \alpha 3GRS + GPMC + GE - Gm\mu - \left(\frac{D}{H}\right) GD + e' \qquad (10)$$

Here it should be noted that (PMC) is the foreign price level, however, it is assumed that domestic prices must keep in line with foreign prices. Then the coefficient of (GE) must take the value of (+ 1.0) as that of GPMC. The exchange rate variable is still a policy variable which may be changed for some reason. But if the exchange rate is left to fluctuate, then the domestic money supply is no longer an endogenous variable.

Both equations of the reduced form of the balance of payments are estimated and the results are given in Table XIX. Equations (9 and 9.1) are estimated under the assumption of fixed exchange rates, while those (10 and 10.1) under some managed floating rates. Concerning equations 9 and 9.1, the estimated coefficients of real income growth (GRY) and (D/H).GD conform to values implied by the hypothesis, while the coefficient of the multiplier growth is different from negative one at 5% level of significance. However the above mentioned three variables which are significant in all equations, their estimates in equation (10) conform to values implied by the hypothesis, that is when the exchange rate is assumed to change and money narrowly defined is concerned. But the credit creation variable coefficient in equation (10.1) is different from (-1) at 5 per cent level of significance. But other coefficients of the price level, exchange rate, the own price of money and the cross price of money are not significant at all in all equations, despite those of the price level and the exchange rate are within the expected value. But with respect to signs, the price variable has a wrong sign in all equations, while the exchange rate has a wrong sign only in equation (10.1).

In general, concerning those three variables, real income, the

TABLE XIX

ANNUAL ESTIMATES OF THE RESERVE FLOW EQUATION; DEPENDENT VARIABLE IS [(NFA/H)GNFA]

	Coefficients of independent variables									
	GRY	GP	GPMC	GE	GRM	GRS	Gmu1	Gmu2	$(\frac{D}{H}).GD$	$\frac{\bar{R}^{2*}}{D.W.}$
(9)	1.083	-0.508	-	-	-0.004	0.042	-3.083[1]	-	-0.974	0.970
	(0.254)	(1.009)	-	-	(0.003)	(0.048)	(0.955)	-	(0.085)	1.491
(9.1)	1.162	-1.212	-	-	-0.003	0.003	-	-2.775[1]	-0.843	0.978
	(0.217)	(0.866)	-	-	(0.003)	(0.043)	-	(0.681)	(0.073)	1.380
(10)	1.222	-	-0.637	0.845	-0.003	0.036	-2.622	-	-0.866	0.968
	(0.375)	-	(0.801)	(2.314)	(0.003)	(0.044)	(1.270)	-	(0.082)	1.502
(10.1)	1.072	-	-0.069	-0.219	-0.001	-0.025	-	-2.713	-0.798[1]	0.969
	(0.411)	-	(0.955)	(2.594)	(0.003)	(0.051)	-	(1.283)	(0.082)	1.086

*$\bar{R}^2$ and D.W. are given respectively in the column. mul is multiplier of (M1) and mu2 is multiplier of (M2).

[1]The coefficient is different from (-1) at level 5%.

Note: Growth of real money balances in both its definitions is regressed on GRY, GRM, and GRS, and the estimated income elasticity is found to be significant and not different from one, while the other two elasticities are not significant but are within the range shown in the table.

money multiplier, and the credit creation, which are the dominant factors influencing the Libyan reserve flow, the results taken together suggest that the Libyan reserve flow experience during the period (1962-1977) are in conformity with the monetary approach to the balance of payments. Zecher (109, p. 287-97) has estimated a similar reduced form of the BOP on the Australian economy coming up with similar results, although his is better in having the positive expected value for the price level. As the domestic output is not sensitive to prices, therefore the price increase whether it is of domestic origin or imported from abroad, leads to increase the value of imports, and the latter tend to decrease the reserve flow since these reserves are gained from oil exports which is independent of the price level. That is the negative sign of the price level which is not associated with the theoretical view, reflects the actual behavior of the Libyan economy. But as it is insignificant, it may be ignored in this respect. However it is argued that such a reduced form might give biased results, because Durnbusch (32) concluded that there is not much use in considering a reduced form equation of the balance of payment, if such equation is not derived from the general equilibrium and macroeconomic system. This argument will be investigated in Chapter VIII by making a comparison between net foreign assets simulated by the complete model and by the reduced single equation model.

CHAPTER VII

TWO STAGE LEAST SQUARES ESTIMATIONS

The use of two stage least squares (2SLS), as a method for estimating parameters, yields consistent but not asymptotically efficient estimates because it "does not take into account the correlation of the structural disturbances across equations" (65, p. 562). Therefore an attempt has to be made to reestimate the model by the 2SLS method. Since the number of predetermined variables in the model is large, it is necessary to find an alternative means of determining instruments in a small number, because according to Pindyck and Rubinfeld (90, p. 277), 2SLS presents no computational problems if "the number of predetermined variables in the reduced form of the model is relatively small (less than 20)[1]. The procedure followed here is that those predetermined variables which are highly correlated with the endogenous variables in each equation are selected as instruments in

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[1]An attempt is made to reduce the number of predetermined variables through the technique of the principal components as indicated by Johnston (59, p. 322). That is to say, the predetermined variables are transformed into a new set of variables, say $P_1 P_2 \ldots P_9$ as given by the (TSP) computer program. These nine components explain more than 98 per cent of the variance in our sample, the first five components explain more than 95 per cent of the variance. So they are reasonable to be used as instruments in our equations. But the nature of our model showed that the technique of principal components is inappropriate for it, because four of our behavioral equations are directly determined by only exogenous variables.

that equation. This is in addition to the existing predetermined variables in the equation.

However, since the model is block recursive,[2] "the right hand endogenous variables need not be correlated with the error terms. This property of recursive models makes ordinary least squares an appropriate estimation procedure" (90, p. 269).

However, the model is reestimated by the 2SLS method and the results are summarized in Tables XX and XXI. The corresponding results obtained by the OLS method are also summarized in these tables for the purpose of comparison. It is found that the estimates by the OLS method are a little bit superior to those estimates by the 2SLS method in equations (1), (1.1), and (8) in the linear model and (1), (1.1), (4), (4.1), (8) and (9) in the log-linear model. While the estimates by the 2SLS are superior to those estimates by the OLS method in equations (2), (4), (4.1) and (9) in the linear model and (2) in the log-linear model. But those four behavioral equations, in which none of the dependent variables appears on the right hand side of any equation, have similar results either OLS or 2SLS method is used. These equations are namely: (3), (5), (5.1), (6), and (7), in both linear and log-linear models. There are no differences of sign between OLS and 2SLS estimates.

Then concerning the order condition for identification the entire model is identifiable, since there are five behavioral equations in the model which are overidentified, namely numbers (1), (2), (4), (8), and (9). The remaining four behavioral equations, (3)[3], (5), (6), and

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[2]Assuming MX1 is an exogenous variable.

[3]A better goodness-of-fit is obtained by the (2SLS) method when MX1 is considered as an exogenous variable.

TABLE XX

COMPARISON BETWEEN (OLS) AND (2SLS) ESTIMATES OF THE LINEAR EQUATION MODELS

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(1) OLS:

$$RM1 = \underset{(6.675)}{-20.329} + \underset{(0.021)}{0.170}\,RY - \underset{(50.885)}{171.376}\,RM + \underset{(16.570)}{66.553}\,RS$$

$$- \underset{(0.071)}{0.114}\,RG + \underset{(0.061)}{0.484}\,RM11 + \underset{(7.744)}{28.157}\,DR + \underset{(10.436)}{45.393}\,D76;$$

$\bar{R}^2 = 0.999$; $h = -1.271$; $SD = 6.916$

2SLS:

$$RM1 = \underset{(7.426)}{-17.615} + \underset{(0.023)}{0.169}\,RY - \underset{(60.767)}{208.744}\,RM + \underset{(20.750)}{67.561}\,RS$$

$$- \underset{(0.077)}{0.095}\,RG + \underset{(0.074)}{0.469}\,RM11 + \underset{(8.966)}{27.175}\,DR + \underset{(11.981)}{45.744}\,D76;$$

$\bar{R}^2 = 0.999$; $h = -2.723$; $SD = 7.311$

(1.1) OLS:

$$RM2 = \underset{(10.058)}{-6.031} + \underset{(0.019)}{0.210}\,RY - \underset{(70.169)}{155.618}\,RM + \underset{(22.489)}{68.450}\,RS$$

$$- \underset{(2.601)}{5.394}\,T + \underset{(0.066)}{0.416}\,RM21 + \underset{(12.285)}{42.090}\,DR + \underset{(14.011)}{29.496}\,D76$$

$\bar{R}^2 = 0.998$; $h = -1.442$; $SD = 9.675$

2SLS:

$$RM2 = \underset{(10.679)}{-5.885} + \underset{(0.020)}{0.212}\,RY - \underset{(83.235)}{199.157}\,RM + \underset{(25.833)}{72.748}\,RS$$

$$- \underset{(2.711)}{4.946}\,T + \underset{(0.073)}{0.402}\,RM21 + \underset{(13.314)}{39.865}\,DR + \underset{(15.288)}{30.451}\,D76$$

$\bar{R}^2 = 0.998$; $h = -2.738$; $SD = 10.032$

(2) OLS:

$$P = \underset{(0.462)}{-1.834} + \underset{(0.489)}{2.666}\,PWC - \underset{(0.445)}{2.838}\,(DS.PWC) + \underset{(0.057)}{0.227}\,Ph$$

$$+ \underset{(0.004)}{0.023}\,MX + \underset{(0.459)}{3.011}\,DV;$$

$\bar{R}^2 = 0.984$; $DW = 1.404$; $SD = 0.046$

2SLS:

$$P = \underset{(0.473)}{-1.830} + \underset{(0.510)}{2.661}\,PWC - \underset{(0.457)}{2.834}\,(DS.PWC) + \underset{(0.065)}{0.228}\,Ph$$

$$+ \underset{(0.004)}{0.023}\,MX + \underset{(0.471)}{3.007}\,DV;$$

$\bar{R}^2 = 0.984$; $DW = 1.410$; $SD = 0.046$

TABLE XX (Continued)

(3) (OLS = 2SLS):

$$Ph = \underset{(0.363)}{-0.405} + \underset{(0.0004)}{0.001}\, W + \underset{(0.390)}{1.229}\, PWB + \underset{(0.040)}{0.103}\, MX - \underset{(0.031)}{0.144}\, DR.MX;$$

$$\bar{R}^2 = 0.947; \quad DW = 2.534; \quad SD = 0.142$$

(4) OLS:

$$\left(\frac{CC}{DD}\right)^* = \underset{(0.257)}{0.903} - \underset{(0.00016)}{0.00042}\, RYP + \underset{(6.597)}{26.056}\, rd2 - \underset{(0.322)}{0.977}\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.872; \quad DW = 1.551; \quad \rho_1 = 0.615; \quad SD = 0.088$$

2SLS:

$$\left(\frac{CC}{DD}\right)^* = \underset{(0.257)}{0.902} - \underset{(0.00016)}{0.00042}\, RYP + \underset{(6.598)}{26.048}\, rd2 - \underset{(0.322)}{0.977}\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.872; \quad DW = 1.552; \quad \rho_1 = 0.615; \quad SD = 0.088$$

(4.1) OLS:

$$\left(\frac{CC}{TD}\right)^* = \underset{(0.224)}{0.767} - \underset{(0.00015)}{0.00024}\, RYP + \underset{(5.310)}{16.243}\, rd2 - \underset{(0.259)}{0.768}\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.715; \quad DW = 1.481; \quad \rho_1 = 0.696; \quad SD = 0.073$$

2SLS:

$$\left(\frac{CC}{TD}\right)^* = \underset{(0.225)}{0.771} - \underset{(0.00015)}{0.00025}\, RYP + \underset{(5.303)}{16.278}\, rd2 - \underset{(0.322)}{0.769}\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.715; \quad DW = 1.477; \quad \rho_1 = 0.701; \quad SD = 0.073$$

(5) (OLS = 2SLS):

$$\left(\frac{R}{DD}\right) = \underset{(0.1082)}{1.3671} - \underset{(1.9593)}{20.1419}\, rd2 - \underset{(0.1041)}{0.7001}\left(\frac{DD}{TD}\right) + \underset{(0.000712)}{0.000965}\, AGR;$$

$$\bar{R}^2 = 0.896; \quad DW = 1.601; \quad SD = 0.024$$

(5.1) (OLS = 2SLS):

$$\left(\frac{R}{TD}\right) = \underset{(0.060)}{0.810} - \underset{(1.083)}{15.657}\, rd2 - \underset{(0.058)}{0.222}\left(\frac{DD}{TD}\right) + \underset{(0.00039)}{0.00084}\, AGR;$$

$$\bar{R}^2 = 0.947; \quad DW = 1.619; \quad SD = 0.013$$

(6) (OLS = 2SLS):

$$OY = \underset{(680.35)}{2711.75} + \underset{(0.0766)}{0.6675}\, QX - \underset{(655.65)}{3163.45}\, ES + \underset{(24.843)}{495.085}\, OPX - \underset{(1.190)}{9.113}\, DRLP;$$

$$\bar{R}^2 = 0.993; \quad DW = 2.113; \quad SD = 82.300$$

TABLE XX (Continued)

(7) (OLS = 2SLS):

$$RYP^{*} = \underset{(777.70)}{1899.59} + \underset{(0.125)}{0.628}\ RW - \underset{(75.946)}{43.191}\left(\frac{PK}{P}\right) - \underset{(732.46)}{1839.64}\ E + \underset{(0.517)}{1.392}\ DRLP + \underset{(0.177)}{0.1487}\ RYP1;$$

$\bar{R}^2 = 0.984$; $h = -2.722$; $\rho_1 = -0.551$; $SD = 40.126$

(8) OLS:

$$RMKP^{*} = \underset{(446.62)}{-2295.86} + \underset{(0.078)}{0.7613}\ RYP - \underset{(0.048)}{0.274}\left(\frac{W}{PK}\right) + \underset{(435.22)}{2253.44}\ E - \underset{(23.855)}{50.307}\ E.DE + \underset{(0.297)}{0.683}\ DRM2;$$

$\bar{R}^2 = 0.950$; $DW = 2.922$; $\rho_1 = -0.739$; $SD = 21.938$

2SLS:

$$RMKP^{*} = \underset{(453.75)}{-2387.94} + \underset{(0.079)}{0.778}\ RYP - \underset{(0.048)}{0.278}\left(\frac{W}{PK}\right) + \underset{(442.15)}{2343.05}\ E - \underset{(24.223)}{55.067}\ (E.DE) + \underset{(0.299)}{0.720}\ DRM2;$$

$\bar{R}^2 = 0.950$; $DW = 3.061$; $\rho_1 = -0.749$; $SD = 22.005$

(9) OLS:

$$RMC = \underset{(102.355)}{-558.785} + \underset{(0.013)}{0.088}\ RY + \underset{(16.404)}{107.986}\left(\frac{PMC}{P}\right) + \underset{(99.459)}{520.105}\ E - \underset{(5.224)}{13.454}\ (E.DE) - \underset{(32.385)}{149.005}\ Tr + \underset{(0.077)}{0.430}\ RMC1;$$

$\bar{R}^2 = 0.997$; $h = -1.416$; $SD = 4.465$

2SLS:

$$RMC^{*} = \underset{(73.967)}{-552.928} + \underset{(0.009)}{0.089}\ RY + \underset{(10.429)}{110.026}\left(\frac{PMC}{P}\right) + \underset{(72.118)}{522.506}\ E - \underset{(3.423)}{15.829}\ (E.DE) - \underset{(24.007)}{181.017}\ Tr + \underset{(0.057)}{0.442}\ RMC1;$$

$\bar{R}^2 = 0.998$; $h = -2.377$; $\rho_1 = -0.275$; $SD = 3.043$

*The equation is corrected for serial correlation.

Note: See Appendix 1 for definitions of variables.

TABLE XXI

COMPARISON BETWEEN (OLS) AND 2SLS ESTIMATES OF THE LOG-LINEAR EQUATION MODELS

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(1) OLS:

$$LRM1 = \underset{(0.384)}{-2.338} + \underset{(0.109)}{0.845}\, LRY - \underset{(0.283)}{0.862}\, RM + \underset{(0.085)}{0.211}\, RS - \underset{(0.0001)}{0.0004}\, RG + \underset{(0.084)}{0.377}\, LRM11 + \underset{(0.050)}{0.124}\, DR;$$

$$\bar{R}^2 = 0.998; \quad h = 0.117; \quad SD = 0.039$$

2SLS:

$$LRM1 = \underset{(0.494)}{-2.113} + \underset{(0.143)}{0.765}\, LRY - \underset{(0.381)}{1.038}\, RM + \underset{(0.124)}{0.076}\, RS - \underset{(0.00018)}{0.00035}\, RG + \underset{(0.111)}{0.477}\, LRM11 + \underset{(0.065)}{0.081}\, DR;$$

$$\bar{R}^2 = 0.998; \quad h = -1.108; \quad SD = 0.048$$

(1.1) OLS:

$$LRM2 = \underset{(0.228)}{-1.568} + \underset{(0.090)}{0.802}\, LRY - \underset{(0.256)}{0.831}\, RM + \underset{(0.075)}{0.240}\, RS + \underset{(0.082)}{0.279}\, LRM21 + \underset{(0.043)}{0.171}\, DR;$$

$$\bar{R}^2 = 0.999; \quad h = -1.614; \quad SD = 0.035$$

2SLS:

$$LRM2 = \underset{(0.248)}{-1.507} + \underset{(0.100)}{0.768}\, LRY - \underset{(0.316)}{1.023}\, RM + \underset{(0.100)}{0.230}\, RS + \underset{(0.094)}{0.316}\, LRM21 + \underset{(0.049)}{0.151}\, DR;$$

$$\bar{R}^2 = 0.998; \quad h = -1.209; \quad SD = 0.036$$

(2) OLS:

$$LP = \underset{(0.019)}{0.053} + \underset{(0.404)}{2.052}\, LPWC - \underset{(0.364)}{2.247}\, (DS.LPWC) + \underset{(0.064)}{0.309}\, LPh + \underset{(0.003)}{0.0124}\, MX + \underset{(0.036)}{0.159}\, DV;$$

$$\bar{R}^2 = 0.980; \quad DW = 1.312; \quad SD = 0.035$$

2SLS:

$$LP = \underset{(0.019)}{0.052} + \underset{(0.418)}{2.022}\, LPWC - \underset{(0.373)}{2.224}\, (DS.LPWC) + \underset{(0.069)}{0.317}\, LPh + \underset{(0.0028)}{0.0124}\, MX + \underset{(0.036)}{0.159}\, DV;$$

$$\bar{R}^2 = 0.980; \quad DW = 1.344; \quad SD = 0.035$$

(3) (OLS = 2SLS):

$$LPh = \underset{(0.284)}{-1.192} + \underset{(0.052)}{0.225}\, LW + \underset{(0.271)}{1.066}\, LPWB + \underset{(0.017)}{0.086}\, MX - \underset{(0.016)}{0.094}\, (DR.MX);$$

TABLE XXI (Continued)

$$\bar{R}^2 = 0.962; \quad DW = 2.278; \quad SD = 0.069$$

(4) OLS:

$$L\left(\frac{CC^*}{DD}\right) = \underset{(0.934)}{4.463} - \underset{(0.094)}{0.333}\ LRYP + \underset{(0.189)}{0.834}\ Lrd2 - \underset{(0.188)}{0.561}\ L\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.886; \quad DW = 1.840; \quad \rho_1 = 0.616; \quad SD = 0.104$$

2SLS:

$$L\left(\frac{CC^*}{DD}\right) = \underset{(0.932)}{4.513} - \underset{(0.096)}{0.341}\ LRYP + \underset{(0.188)}{0.835}\ Lrd2 - \underset{(0.187)}{0.655}\ L\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.886; \quad DW = 1.839; \quad \rho_1 = 0.629; \quad SD = 0.104$$

(4.1) OLS:

$$L\left(\frac{CC^*}{TD}\right) = \underset{(1.467)}{5.610} - \underset{(0.192)}{0.577}\ LRYP + \underset{(0.180)}{0.690}\ Lrd2 - \underset{(0.220)}{0.859}\ L\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.773; \quad DW = 1.583; \quad \rho_1 = 0.877; \quad SD = 0.108$$

2SLS:

$$L\left(\frac{CC^*}{TD}\right) = \underset{(1.493)}{5.837} - \underset{(0.1948)}{0.6055}\ LRYP + \underset{(0.179)}{0.688}\ Lrd2 - \underset{(0.221)}{0.880}\ L\left(\frac{WS}{YP}\right);$$

$$\bar{R}^2 = 0.774; \quad DW = 1.578; \quad \rho_1 = 0.883; \quad SD = 0.108$$

(5) (OLS or 2SLS):

$$L\left(\frac{R}{DD}\right) = \underset{(0.564)}{-7.091} - \underset{(0.150)}{1.430}\ Lrd2 - \underset{(0.282)}{2.019}\ L\left(\frac{DD}{TD}\right) + \underset{(0.021)}{0.073}\ LAGR;$$

$$\bar{R}^2 = 0.903; \quad DW = 1.480; \quad SD = 0.075$$

(5.1) (OLS = 2SLS):

$$L\left(\frac{R}{TD}\right) = \underset{(0.564)}{-7.091} - \underset{(0.150)}{1.430}\ Lrd2 - \underset{(0.282)}{1.019}\ L\left(\frac{DD}{TD}\right) + \underset{(0.021)}{0.073}\ LAGR;$$

$$\bar{R}^2 = 0.908; \quad DW = 1.480; \quad SD = 0.075$$

(6) (OLS = 2SLS):

$$LOY = \underset{(0.288)}{-0.540} + \underset{(0.040)}{1.025}\ LQX + \underset{(0.113)}{0.896}\ LOPX - \underset{(1.137)}{2.357}\ LES + \underset{(0.0485)}{0.0415}\ LDRLP;$$

$$\bar{R}^2 = 0.992; \quad DW = 2.193; \quad SD = 0.111$$

(7) (OLS = 2SLS):

$$LRYP = \underset{(0.467)}{0.562} + \underset{(0.160)}{0.582}\ LRW - \underset{(0.184)}{0.466}\ L\left(\frac{PK}{P}\right) - \underset{(0.876)}{1.758}\ LE + \underset{(0.036)}{0.132}\ LDRLP + \underset{(0.123)}{0.255}\ LRYP1;$$

$$\bar{R}^2 = 0.985; \quad h = -1.965; \quad SD = 0.083$$

TABLE XXI (Continued)

(8) OLS:

$$LRMKP = \underset{(0.693)}{-2.511} + \underset{(0.333)}{1.788}\ LRYP - \underset{(0.323)}{0.533}\ L\left(\frac{W}{PK}\right)_{t-1} + \underset{(4.939)}{14.616}\ LE$$

$$- \underset{(4.900)}{13.437}\ (DE.LE) - \underset{(0.077)}{0.138}\ LDRM2;$$

$$\bar{R}^2 = 0.959;\quad DW = 2.335;\quad SD = 0.172$$

2SLS:

$$LRMKP = \underset{(0.713)}{-2.636} + \underset{(0.365)}{1.997}\ LRYP - \underset{(0.350)}{0.718}\ L\left(\frac{W}{PK}\right)_{t-1} + \underset{(5.053}{14.177}\ LE$$

$$- \underset{(5.076)}{12.101}\ (LE.DE) - \underset{(0.079)}{0.135}\ LDRM2;$$

$$\bar{R}^2 = 0.957;\quad DW = 2.745;\quad SD = 0.176$$

(9) OLS:

$$LRMC = \underset{(0.311)}{-0.477} + \underset{(0.134)}{0.342}\ LRY + \underset{(0.165)}{0.835}\ L\left(\frac{PMC}{P}\right) + \underset{(1.865)}{1.402}\ LE$$

$$- \underset{(1.906)}{0.819}\ (LE.DE) - \underset{(0.127)}{0.524}\ LTr + \underset{(0.129)}{0.517}\ LRMC1;$$

$$\bar{R}^2 = 0.996;\quad h = 0.746;\quad SD = 0.046$$

2SLS:

$$LRMC = \underset{(0.347)}{-0.402} + \underset{(0.155)}{0.302}\ LRY + \underset{(0.167)}{0.821}\ L\left(\frac{PMC}{P}\right) + \underset{(1.916)}{1.641}\ LE$$

$$- \underset{(1.978)}{1.089}\ (LE.DE) - \underset{(0.134)}{0.544}\ LTr + \underset{(0.147)}{0.556}\ LRMC1;$$

$$\bar{R}^2 = 0.951;\quad h = -0.773;\quad SD = 0.046$$

Note: L is a prefix to the variable to denote log.

*The equation is corrected for serial correlation.

(7), including only exogenous variables as explanatory variables, and hence are identified. The remaining eleven identities are also identified.

Equations (1) and (1.1) (Table XX) which are estimated by (2SLS) procedure have a serial correlation as indicated by Durbin-h test, but when these equations are corrected for such serial correlation (ρ_1) turns out to be greater than one which may indicate that the time series is non-stationary. Therefore, despite the corrected equations for serial correlation showing better results in terms of lower standard deviations and higher t-values, they are ignored.

The selection of the best set of the behavioral equations shall be considered in the following chapter when the equations model are used for the purpose of historical simulation. The mean absolute percentage error (MAPE) shall be taken as the principal criterion of such selection.

CHAPTER VIII

MODEL SIMULATION AND VALIDATION

In general, the extent to which a model is satisfactory can be tested by its ability to generate values which are approximately similar to the true values. Therefore, it is appropriate to simulate and then examine these predicted values and their relationship to the actual values. In the econometric literature (90, 315-19), there are several types of goodness-of-fit measures which may be used. In this chapter, the following measures are calculated:

1. The mean absolute percentage error (MAPE).

$$MAPE = \frac{1}{T} \sum_{t=1}^{T} \frac{|\hat{y}-y|}{y} \cdot 100$$

2. Regression coefficient of actual on predicted values (B1), then a B1 = 1 implies an exact linear relationship between actual and predicted values while a small value of (B1) approaching zero indicates that the regression is very bad.

3. The regression correlation is another measure that can be used in this respect.

4. Theil's inequality coefficient (U) is also considered a good measure of goodness-of-fit, and the value of (U) ranges between zero and one, so that when u = 0 a perfect simulation exists, while a value

of unity denotes the other extreme.

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(\hat{y}-y)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\hat{y}^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}y^2}}$$

5. The ability of the model to track the turning points during the historical period is an important measure for the validity of the model. Kost (66, p. 7) indicates three definitions of turning point errors, but they are similar and lead to the same value. However, the simplest one is that a turning point error (TPE) can be defined as the number of turning points missed (TPm) in the historical actual data divided by the number of turning points (TP).

$$TPmE = \frac{TPm}{TP}$$

Thus, expressing this error in proportional terms may be taken as a measure of turning point error. Its value ranges between zero and one. A value of zero indicates a perfect turning point simulation, while a value of one indicates the other extreme, that is, all are missed.

Four sets of the equations model which are listed in Tables XX and XXI (linear, log-linear, OLS, and 2SLS) are simulated and the results of the mean absolute percentage errors are summarized in Table XXII.

MX1 is treated as exogenous in order to be able to choose the

TABLE XXII

THE MODEL HISTORICAL DYNAMIC SIMULATION (1963-1977): A COMPARISON BETWEEN LINEAR AND NONLINEAR MODEL

D. Var.	$\bar{Y}$	MAPE: Linear OLS	MAPE: Linear 2SLS	MAPE: Log Linear OLS	MAPE: Log Linear 2SLS	The Chosen Model: Equation Form	The Chosen Model: Method of Estimate	The Chosen Model: MAPE
RM1	241.4	7.90	7.92	7.52	7.37	Log-Linear	2SLS	7.37
P	1.521	2.08	2.07	1.97	1.89	"	"	1.89
Ph	1.802	5.48	5.48	4.46	4.45	"	"	4.45
(CC/DD)	0.835	10.50	10.46	11.79	12.00	Linear	"	10.26
(R/DD)	0.316	5.78	5.78	5.45	5.45	"	"	5.78
RM	0.0595	183.4	193.8	199.5	190.3	Identity	–	276.2
RS	0.1277	181.4	184.8	222.9	241.2	"	–	227.9
MS1	429.4	40.13	25.15	34.14	34.32	"	–	34.65
MU1	1.221	1.80	1.80	1.73	1.75	"	–	1.77
H	336.0	40.04	25.37	34.17	34.40	"	–	34.55
NFA	591.8	23.63	15.32	20.61	20.64	"	–	20.79
NM	640.0	6.76	9.04	3.08	3.18	"	–	3.04
OY	1115.5	7.17	7.13	6.57	6.57	Log-Linear	OLS	6.57
RYP	498.0	6.27	6.26	4.73	4.73	"	"	4.73
GDP	1971.3	4.43	4.44	3.57	3.59	Identity	–	3.59
Y	1784.5	4.89	4.91	4.06	4.08	"	–	4.08
RY	1018.0	4.87	4.83	4.91	4.87	"	–	4.87
RMKP	115.8	13.73	19.07	8.89	9.95	Log-Linear	OLS	8.89
RMC	111.0	5.59	5.48	3.03	2.78	"	2SLS	2.78
RM2	278.5	6.89	7.27	6.71	6.56	"	"	6.56
(CC/TD)	0.612	14.40	14.29	112.4	131.0	Linear	"	13.94
(R/TD)	0.236	4.58	4.58	5.45	5.45	"	"	4.58
MS2	494.4	40.23	25.60	36.27	38.07	Identity	–	34.26
MU2	1.445	2.74	2.73	10.46	11.40	"	–	2.68

Note: $\bar{Y}$ is in million L.D. or index number or otherwise, as the value of the dependent variable is supposed to be.

best set of those estimated equations.[1] The (MAPE) mentioned above is taken as a basis for choosing the best equation from those different techniques of estimation; the lower the (MAPE) is, the better is the equation. Table XXII shows the (MAPE) resulting from a dynamic simulation during the historical period. In these simulations the model is wholly recursive and the money supply appeared with a high (MAPE) amounting to about 34 per cent resulting from the same level of error in the monetary base (H). The latter error arises partly from that error exists in net foreign assets estimates. The other two high percentage errors exist in the rate of inflation (RM) or the opportunity cost of holding money, and the rate of inflation in the housing sector (RS), or the price of the alternative asset to money. Their errors are as much as twice their actual values although their effect on the demand for money is not harmful resulting from the fact that their amounts are so small. But it is instructive to note that the general price index and the housing price index, from which (RM) and (RS) are calculated, show only an error of about 2.0 percent and 5.0 percent, respectively.

The percentage error of other dependent variables ranges between 1.8 percent to 10.0 percent. Therefore the best set of the model is chosen and it is shown in the last three columns of Table XXII. That is, the model contains: four equations, numbers 1, 2, 3 and 9 in log linear forms and estimated by the (2SLS) method, two equations, numbers 4 and 5 in linear forms and estimated by the (2SLS) method, and three

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[1]When the variable (MX1) - an index of money as a proxy for demand pull inflation in the price equations - is considered as endogenous, the system becomes unstable.

equations, numbers 6, 7 and 8 in log linear forms and estimated by the (OLS) method.

The Chow-test of stability was used to investigate this chosen model since it contains only recursive equations.[2] The test results as summarized in Table XXIII suggest that the hypothesis of stability for these nine behavioral equations is not rejected. Therefore, this model is stable during the whole period and able to predict more appropriate predicted values relative to actual values.

TABLE XXIII

RESULTS OF THE CHOW TEST FOR STABILITY OF THE CHOSEN MODEL

Equation	Dep. variable	Critical F	Calculated F
1	LRM1	237	0.875
1.1	LRM2	8.94	-0.478
2	LP	6.16	2.294
3	LPh	4.39	0.220
4	(CC/DD)	3.84	1.990
4.1	(CC/TD)	3.84	2.314
5	(R/DD)	4.53	1.987
5.1	(R/TD)	4.53	1.288
6	LOY	5.05	1.043
7	LRYP	8.94	0.586
8	LRMKP	8.94	0.586
9	LRMC	237	0.044

[2]A system of equations is recursive if each of the endogenous variables can be determined sequentially, for further discussion see Pindyck and Rubinfeld (90, p. 269).

The revised model is simulated in which MX1 is treated as an endogenous variable. The best results are obtained when a static simulation is performed during the historical period 1963-77 and the out of sample forecasted year (1978). These simulation results still exhibit a higher percentage error for RM and RS while all the other dependent variables appeared to be reasonable as their (MAPE) range between 2 percent and 11 percent. According to the static simulation of the model, the model is stable. This system of equations has eleven simultaneous equations in one block and nine recursive equations in two blocks.[3] For comparison between equations the main measures of goodness-of-fit for each endogenous variable are calculated. But it is found that these measures which mentioned above are all good for comparison between equations and lead to the same conclusion. However, it seems that (MAPE) is more relevant measure in this respect, which suggest that both static and dynamic simulation results are satisfactory, as shown in Table XXIV. But when the dynamic simulation is performed to the model, it is found that the model is stable only during the period (1963-1971). Other measures of goodness-of-fit[4] for each endogenous variable, such as R^2, B1, Theil's U and the turning points missing error are also plausible and suggest, in general, that the static and dynamic simulation results are satisfactory. But these results indicate that dynamic simulation is superior to static

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[3]The computer solved the linear equations system in the following order: (a) 6 recursive equations in the first block namely: (R/DD), OY, RYP, RMKP, (CC/DD) and MU1. (b) Eleven simultaneous equations in the second block namely: P, Ph, RMC, MS1, RY, H, GDP, Y, NFA, NM, MX1. (c) Three recursive equations in the third block namely: RM, RS and RM1.

[4]These measures can be seen in appendices 1 and 2.

TABLE XXIV

GOODNESS-OF-FIT FOR EACH ENDOGENOUS VARIABLE DURING THE PERIOD (1963-1978) INCLUDING THE FORECASTED YEAR

Endogenous Variable	Static Simulation MAPE	Static Simulation MAPE (1)	Static Simulation 1978 $(\frac{Y-\hat{Y}}{Y})$ %	Dynamic Simulation[(2)] MAPE
RM1	8.335	7.573	19.76	7.974
P	2.067	2.179	0.39	2.971
Ph	5.443	4.183	24.35	5.500
(CC/DD)	11.785	10.262	34.62	7.125
(R/DD)	5.583	5.779	2.64	7.181
OY	7.200	6.566	-16.70	6.901
RYP	7.054	5.029	37.43	4.707
RMKP	9.387	8.340	25.10	9.138
RMC	3.877	3.616	7.78	2.783
RM	190.6	203.17	1.97	225.7
RS	137.8	142.47	67.70	84.7
MS1	6.298	5.118	-24.00	42.72
MU1	2.030	1.751	- 6.21	1.555
MX1	6.325	5.147	-24.00	42.74
GDP	3.629	3.374	7.46	2.983
Y	4.086	3.824	7.92	3.428
RY	5.084	4.919	7.56	4.164
NM	3.171	2.668	10.71	2.455
NFA	3.562	2.831	-14.53	25.80
H	5.775	5.044	-16.74	42.65

(1) Represents the historical period only (1963-1977).

(2) Represents the period (1963-1971) because the model is only stable during this period when a dynamic simulation is performed to the model. Its instability during the rest of the period is indicated by the Time Series Processor (TSP) computer program; that is the system diverges in 1972.

simulation, if the real sector is mostly concerned, taking the MAPE as the criteria, while it is inferior to the static simulation, if the monetary sector is mostly concerned. However, using all measures of goodness-of-fit for the model, the static simulation appears to be plausible and preferable, especially since it covers all the historical periods and the forecasted period.

The model simulation is also performed using money broadly defined (M2), and it is found that most results are inferior to that of those simulations using the narrowly defined money. But it is useful to note that the dynamic simulation using (M2) diverges only in 1973. That is, one more period is stable when (M2) is involved in the model system.

According to the dynamic simulation, the predicted money supply shows a higher level of (MAPE) amounting to 42.72 percent, resulting from a similar percentage error occurring in the monetary base, and the latter error is mostly caused by the balance of payments identity as the percentage error accounted for 25.8 percent in the net foreign assets (NFA) variable. This high percentage error in NFA variable suggests that the model instability during the last six periods of the historical periods is caused by the foreign sector which is represented by the balance of payments equation. Thus it is fruitful and preferable to investigate further the appropriateness of considering the net foreign assets as an exogenous variable; that is to say, the monetary base becomes an exogenous variable. Therefore, by eliminating the balance of payments equation, the reduced model becomes stable whether the simulation performed is static or dynamic during the whole period under discussion. But a close glance at the results of both simulations shows that the results of the dynamic simulation are similar to those from the static simulation. However, it is true that some variables perform slightly worse and other variables slightly better. The static simulation yields a lower level of MAPE for: RMKP, RS, MS1, MU1, GDP, and Y, while the dynamic simulation gives a lower level of MAPE for the variables RM1, RYP, RMC, and RM1. The remaining variables are equal in both simulations. But in general the static simulation performs somewhat better than the dynamic simulation, as their results are summarized in Table XXV when the real sector is concerned. That is, the static simulation yields a MAPE of 4.025 per cent in the predicted value of (y) compared to 4.114 per cent yielded by the dynamic simulation. In addition other measures of goodness-of-fit suggest also that the static simulation is superior to dynamic simulation when (y) is concerned.

Here it is likely to note that when broadly defined money is used in both simulations, most variables perform slightly worse and a few variables, namely RM2, (R/TD), RMC, GDP, Y and RY have a slightly lower mean absolute percentage error than that when the narrowly defined money is used in the static simulation (Table XXV). But even these few variables can be ignored since the decrease in the MAPE is negligible.

Now then, a comparison between the complete model and the reduced model (excluding the foreign sector) should be considered. According to the static simulation which was performed over 1963-1978, most important variables show a lower (MAPE) when the whole model is applied.

That is to say, the complete model indicates more accurate estimates with respect to demand for money, housing prices and gross

TABLE XXV

GOODNESS-OF-FIT FOR EACH ENDOGENOUS VARIABLE, 1963-1978
(THE REDUCED MODEL)

D. Var.	Static Simulation			Dynamic Simulation		
	MAPE	MAPE (1)	1978 $(Y-\hat{Y})/Y\%$	MAPE	MAPE (1)	1978 $(Y-\hat{Y})/Y\%$
I: Using the narrow definition of money:						
RM1	7.912	7.809	9.452	7.545	7.481	8.511
P	2.279	1.982	6.729	2.280	1.981	6.766
Ph	5.248	4.253	20.185	5.247	4.253	20.161
(CC/DD)	11.785	10.262	34.625	11.762	10.257	34.340
(R/DD)	5.583	5.780	2.637	5.583	5.780	2.637
OY	7.200	6.566	-16.703	7.200	6.566	-16.703
RYP	7.054	5.029	37.428	6.810	4.727	38.060
RMKP	9.387	8.340	25.097	9.992	8.891	26.500
RMC	3.756	3.571	6.525	3.076	2.815	6.992
RM	182.31	192.17	34.357	186.8	196.1	47.502
RS	143.68	149.53	55.970	215.0	225.4	60.057
MS1	2.030	1.751	- 6.220	2.039	1.764	- 6.161
MU1	2.030	1.751	- 6.209	2.039	1.764	- 6.153
MX1	2.005	1.725	- 6.212	2.014	1.738	- 6.159
GDP	3.905	3.549	9.240	3.995	3.627	9.519
Y	4.386	4.025	9.804	4.491	4.114	10.100
RY	4.898	5.006	3.274	4.861	4.947	3.577
II: Using the broad definition of money:						
RM2	7.232	7.653	0.914	6.850	6.955	5.269
P	3.611	3.074	11.673	3.610	3.073	11.673
Ph	5.159	4.397	16.581	5.156	4.394	16.581
(CC/TD)	15.408	13.998	36.554	15.328	13.928	36.316
(R/TD)	4.425	5.583	2.067	4.425	4.583	2.067
OY	7.200	5.566	-16.703	7.200	6.566	-16.703
RYP	7.054	5.029	37.428	6.810	4.727	38.061
RMKP	9.387	8.340	25.097	9.992	8.891	26.500
RMC	3.631	3.509	5.466	3.099	2.961	5.169
RM	284.9	300.0	59.378	208.3	218.8	49.959
RS	116.0	120.7	46.020	203.8	213.6	57.214
MS2	3.087	2.678	- 9.215	3.087	2.682	- 9.163
MU2	3.087	2.678	- 9.208	3.087	2.684	- 9.136
MX2	3.116	2.910	- 9.212	3.115	2.711	- 9.180
GDP	3.950	3.507	10.600	3.943	3.480	10.879
Y	4.437	3.985	11.247	4.435	3.961	11.543
RY	5.120	5.431	0.462	5.069	5.396	0.135

(1) Represents the historical period.

national product in both nominal and real terms while the estimate of money supply appears to be less accurate than that given by the reduced model simulation, because there is a mean absolute percentage error of 5.0 percent in the monetary base which is wholly reflected in the money supply variable. The money supply estimate shows a (MAPE) of 5.118 percent in the historical period when the complete model is simulated compared to only 1.751 percent resulting from the reduced model simulation. Therefore, if the money supply estimation is mostly concerned, it is more appropriate to consider the reduced model. However, a five percent error or less is a standard used in the economic forecasts, and hence it is preferable to consider the complete model so that changes in net foreign assets variable which reflects the Libyan economic activities in the foreign sector is left free to influence the domestic economic activities involved in the complete model.

The complete model predicts also net foreign assets and net imports of goods and services with a lower MAPE amounting to 2.83 per cent and 2.67 per cent respectively.[5]

The Sensitivity of the Model

Pindyck and Rubinfeld (90, p. 314) indicate that the sensitivity of the model to the initial period in which the simulation is begun, is another evaluation criterion. That is, "if the model truly represents the

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[5]The complete model is still superior to the Johnson's equation model in the Libyan case if the predicted value of NFA variable is concerned, because the single equation model predicted the net foreign assets variable during the period (1964-1977) with a mean absolute percentage error of 5.6 per cent, compared to only 2.7 per cent when the complete model is applied during the same period.

real world, then it should not matter very much in what year the simulation is begun." Therefore the historical period is divided into period one (P1 = 1963-1969) and period two (P2 = 1970-1977), and a static simulation is performed to the complete model during each period. Then a comparison between the results of these simulations and those of the whole period is considered.

The changes in all measures of goodness-of-fit can be used as indicators for sensitivity, but the more relevant measures used in this study are the mean absolute percentage error MAPE, and the regression coefficient of actual on predicted B1. It may be more appropriate to use two different measures rather than one, because using, for example the MAPE alone may indicate a high difference resulting from extreme values of MAPE as the case of the variable RS in Table XXVI indicating a high level of sensitivity in both periods, while B1 indicates that this variable is not sensitive in these periods as the difference is close to zero. Another example is that the demand for money is insensitive to changing initial period if MAPE is taken as a criterion while it may be considered sensitive during the first period if B1 is the criterion. Table XXVI summarizes the sensitivity test of the complete model during the main two periods. Therefore if the 5 per cent level of error is acceptable in the whole period, a 2.5 percentage points must be acceptable in the difference in each period. Thus according to this criterion there are only three variables, namely: (CC/DD), RM and RS, which are very sensitive in both periods, while the rest of the variables are not sensitive to changing periods. So that the model, in general, is insensitive to changing periods and hence the complete model truly represents the real world during the whole historical period. But it should be noted

TABLE XXVI

MEASURES OF THE MODEL SENSITIVITY

D. var.	1963-77		P1: (63-69)		P2: (70-77)		ΔMAPE		ΔB1	
	MAPE	B1	MAPE1	B1.1	MAPE2	B1.2	P1	P2	P1	P2
RM1	7.569	0.990	7.506	0.864	7.624	0.985	- 0.063	- 0.055	-0.126	-0.005
P	2.179	1.015	2.471	1.093	1.923	0.938	0.292	0.256	0.078	-0.077
Ph	4.182	1.011	4.770	0.993	3.668	1.008	0.588	- 0.514	-0.018	-0.003
(CC/DD)	10.262	1.078	5.439	0.619	14.483	0.745	- 4.823	4.221	-0.459	-0.330
(R/DD)	5.780	1.028	8.164	1.398	3.693	0.855	2.384	- 2.087	0.370	-0.173
OY	6.566	0.976	6.856	0.852	6.312	0.942	0.290	- 0.254	-0.124	-0.034
RYP	5.030	0.996	5.470	1.050	4.646	0.996	0.440	- 0.384	0.054	0.000
RMKP	8.340	1.004	6.820	0.945	9.670	0.993	- 1.520	1.330	-0.159	-0.011
RMC	3.615	0.999	3.263	0.993	3.923	1.004	- 0.352	0.308	-0.006	0.005
RM	203.2	0.684	336.1	0.683	86.92	0.744	132.9	-116.3	-0.001	0.060
RS	142.5	0.942	49.0	0.905	224.3	0.951	- 93.5	81.8	-0.037	0.009
MS1	5.118	0.986	5.288	0.999	4.969	0.982	0.170	- 0.149	0.013	-0.004
MU1	1.752	0.873	1.689	0.953	1.807	0.795	- 0.063	0.055	0.080	-0.078
MX1	5.147	0.986	5.356	0.999	4.963	0.982	0.209	- 0.184	0.013	-0.004
GDP	3.373	0.987	2.543	0.949	4.100	0.966	- 0.830	0.727	-0.038	-0.021
Y	3.830	0.986	2.897	0.935	4.646	0.965	- 0.933	0.816	-0.033	-0.021
RY	4.918	0.970	3.231	0.901	6.395	0.942	- 1.687	1.477	-0.069	-0.028
NM	2.669	0.998	2.306	1.010	2.986	0.992	- 0.363	0.317	0.012	-0.006
NFA	2.808	0.994	2.956	0.947	2.678	0.989	0.148	- 0.130	0.003	-0.005
H	5.044	1.001	4.806	0.987	5.252	1.015	- 0.238	0.208	-0.014	0.014

ΔMAPE = MAPEi - MAPE; i = 1, 2.

ΔB1 = B1 - B1.i.

here that the difference in B1 of (CC/DD) supports the insensitivity result, resulting from the fact that the currency-demand deposit ratio was fluctuating up and down since the year 1968. However, this variable does not have much influence on the model as it appears only in the money multiplier identity, and the money multiplier is insensitive as the differences of both measures are very close to zero.

The Dynamic Multipliers

A change in an exogenous variable in the model is likely to affect endogenous variables so that those changes in the endogenous variable are called dynamic multipliers.[6] There are three different multipliers

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[6]If the structural relationships are linears in the parameters, the derived reduced form can be computed from the estimates of the structural parameters as follows:

$$\Gamma Y + BX = U$$

where Γ is the coefficient matrix of the endogenous variables (NXN), Y is the column vector of the endogenous variables (NX1), B is the coefficient matrix of the exogenous variables (NXK), X is the column vector of the exogenous variables (KX1) and U is the vector of disturbance terms (NX1).

Then the reduced model is derived by pre-multiplying the matrices by the inverse of the matrix Γ to get

$$Y = \Gamma^{-1}BX + \Gamma^{-1}U$$

$$\text{or } Y = \pi X + V$$

where π relates each endogenous variable to all predetermined variables affecting the endogenous variable and stochastic disturbance terms. That is the multiplier in this case is the derivative of endogenous variable with respect to exogenous variable

$$\frac{\partial Y}{\partial X} = \pi = -\Gamma^{-1}B$$

But this approach is not appropriate for a non-linear model such as that of this study. Therefore the estimates of the model's structure parameters are used in calculating dynamic multipliers. Gauss-Siadel iteration algorithm available in Time Series Processor (TSP) was used to compute the multipliers. Each exogenous variable was increased by one unit and the impacts on the endogenous variables were observed.

to consider: impact multipliers, interim multipliers and total (or long run) multipliers. The impact multipliers indicate the initial change in an endogenous variable during the first period resulting from one unit change in an exogenous variable, while those dynamic multipliers within a given time period are called the interim multipliers. The total long run multiplier is the total effect on each endogenous variable; (90, p. 347; 27, p. 74; 49, p. 11). However, the impact and total long run multipliers are mostly utilized in empirical studies. If the model is stable, it is expected that the dynamic multipliers are diminishing and converge to zero (79, p. 808; 90, p. 346-7). Therefore, these multipliers are considered another check on the stability of the model.

In this study, the effects of four policy variables on the endogenous variables are investigated. Three of them are monetary policy variables, namely: claims on government (CG), claims on the private sector (CP) and the exchange rate (E), while the other policy variable is the net earnings of foreign exchange from the oil sector (NX) which is subject to fiscal policy. These net earnings are expected to be deposited with the Central Bank.

Claims on the Government (CG) and the Private (CP) Sector

Since CG and CP are independent variables in the monetary base identity, therefore one unit increase in (CG) or (CP) leads to an immediate effect on the monetary base (H). Table XXVII summarizes the impact and total long run multipliers of the policy variables with respect to each endogenous variable. Thus one million dinar increase in (CG) lead to an

TABLE XXVII

IMPACT AND TOTAL MULTIPLIERS OF THE POLICY VARIABLES

Endogenous Variable	one unit increase in CP or CG		one percentage point decrease in E		one unit increase in NX of the oil sector	
	Impact	Total	Impact	Total	Impact	Total
RM1	-0.010	- 1.595	1.239	57.053	-0.010	- 1.595
P	0.0004	0.0131	-0.020	- 0.204	0.0004	0.0131
Ph	0.0025	0.0038	0.0006	- 0.0944	0.0025	0.0041
(CC/DD)	0.0	0.0	-0.0010	- 0.0603	0.0	0.0
(R/DD)	0.0	0.0	0.0	0.0	0.0	0.0
OY	0.0	0.0	0.0	0.0	0.0	0.0
RYP	0.0	0.0	2.406	143.433	0.0	0.0
RMKP	0.0	0.0	-3.365	- 8.554	0.0	0.0
RMC	0.0	- 0.108	-0.330	- 8.425	0.0	- 0.109
RM	0.0004	0.0126	-0.0205	- 0.1593	0.0004	0.0127
RS	0.0027	0.0067	0.0006	0.0243	0.0027	0.0068
MS1	1.280	16.911	6.329	51.171	1.280	16.911
MU1	0.0	0.0	0.0002	0.0120	0.0	0.0
Y	0.049	4.162	-0.270	163.608	0.049	4.162
RY	-0.037	- 2.886	4.476	196.757	-0.037	- 2.886
NM	0.022	1.139	-4.945	- 39.985	0.022	1.139
NFA	-0.022	- 0.651	4.945	39.986	0.978	13.857
H	0.978	13.855	4.945	39.977	0.978	13.855

Note: One unit = one million dinar; one percentage point = 0.01.

impact multiplier on (H) amounting to 0.978 and a total long run multiplier of 13.855 during these fifteen periods. That is a one million dinar increase in claims on government brings an increase of L.D. 0.978 million and L.D. 13.855 million in the monetary base in the first period and in the long run, respectively. Consequently the increase in (H) leads to an increase in the money supply amounting to L.D. 1.280 million in the first period and L.D. 16.911 million in the long run. But these increases in the money supply affect the real sector through prices, so that the consumer price level increased by 0.0004 in the short run and 0.0131 in the long run, and the price level of housing (Ph) increased by 0.0025 and 0.0041 in the short and long runs, respectively. But small negative changes in (Ph) arose during the period (1968-1977) indicating a backward shift in demand for investment in the housing sector.

The rate of inflation (RM) is also increased by 0.0004 and 0.0126 in the short and long runs respectively. While the inflation rate in the housing sector (RS) is increased by 0.0027 in the short run and 0.0067 in the long run. The latter is lower than the increase in the rate of inflation, because most interim multipliers during the second period are low and negative. These price increases may contribute also to money supply increases, because households and business firms tend to hold more money for transactions. But since the effect of RM dominates the effect of (RS) in our money demand function, therefore money demanded decreases.

The price increases stimulates an increase in gross national product in nominal terms (Y) amounting to L.D. 0.049 million in the first period and L.D. 4.162 million in the long run. But because of competitive prices of imports, net imports (NM) shows an increase of

L.D. 0.022 million in the first period and L.D. 1.139 million in the long run, and consequently net foreign assets decreased by the same immediate effect on net imports. Thus 2.2 per cent of that one million increase in credits to government or the private sector is spent on imports in the first period. It seems that the national product does not increase to maintain a constant real gross national product (RY). Therefore RY decreases by L.D. 0.037 million during the first period and by L.D. 2.886 million in the long run. This result arises from the fact that the gross domestic product of the oil sector (OY) is independent of the price level in the model, so that when prices increase, the real value of (OY) decreases. Thus real gross national product must decrease when the non-oil real gross domestic product is unchanged. Finally the decrease in real GNP and the increases in both types of prices bring a decrease in demand for money amounting to L.D. 0.010 million in the short run and L.D. 1.595 million in the long run.

Concerning the time dimension, the multipliers of (CG) with respect to (H)[6] and (MS1) are decreasing during the period 1963-1969, then they rise promptly in 1970 and start diminishing since then while the variables P, Ph and RMC were at equilibrium during the years (1964-1967) and (1970-1973) (Table XXVIII). The rest of the variables did not show the diminishing trends of the multipliers. However the model simulation by the (TSP) program assures the model stability.

The Exchange Rate

In the case of Libya, the exchange rate is fixed, so that money

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[6] It is not shown on the table as it is reflected wholly and directly in the money supply.

TABLE XXVIII

EFFECTS OF POLICY VARIABLES ON SELECTED ENDOGENOUS VARIABLES

	one million dinar increase in CG or CP or NX					one percentage point decrease in (E)				
	P	Ph	Y	MS1	RM1	P	Ph	Y	MS1	RM1
1963	0.0004	0.0025	0.049	1.280	-0.010	-0.020	0.0006	-0.270	6.329	1.239
1964	0.0012	0.0025	0.194	1.125	-0.056	-0.020	0.0046	-0.196	7.215	1.457
1965	0.0012	0.0025	0.218	1.069	-0.071	-0.021	0.0112	-0.108	7.863	1.912
1966	0.0012	0.0028	0.261	1.057	0.084	-0.016	0.0019	1.562	10.892	1.838
1967	0.0011	0.0028	0.284	0.976	0.091	-0.020	0.0142	1.027	10.588	2.473
1968	0.0014	-0.0070	0.496	0.929	0.221	-0.016	0.0168	2.803	13.517	3.174
1969	0.0055	-0.0011	2.270	0.374	0.815	-0.016	0.0326	-4.190	14.525	3.762
1970	0.0004	-0.0003	0.120	1.166	0.067	-0.032	-0.0182	1.600	13.518	6.617
1971	0.0004	-0.0003	0.150	1.073	0.073	-0.003	-0.0165	10.770	-1.834	1.870
1972	0.0004	-0.0003	0.170	1.032	0.077	-0.003	-0.0172	12.270	-2.173	2.319
1973	0.0004	-0.0004	0.280	1.092	0.127	-0.004	-0.0212	17.930	-4.785	3.489
1974	-0.0004	-0.0004	0.370	1.059	0.166	-0.006	-0.0247	26.480	-5.245	4.588
1975	0.0019	0.0018	-1.710	2.509	0.729	-0.009	-0.0250	24.210	-7.171	6.325
1976	0.0005	-0.0005	0.480	1.090	0.217	-0.011	-0.0235	30.070	-4.680	8.928
1977	0.0005	-0.0005	0.530	1.080	0.248	-0.007	-0.0300	39.650	-7.450	7.062
Total long run multiplier	0.0131	0.0041	4.162	16.911	1.595	-0.204	-0.0944	163.608	51.171	57.053

income (or price level) moves to equilibrate the demand for and supply of domestic goods and services. Thus the monetary policy is directed toward the foreign balance by using the exchange rate in order to affect the relative prices and hence to correct the external disequilibrium. The price level tends to rise as there is a surplus in the balance of payments. Therefore an appreciation of the currency (a decrease in the exchange rate in terms of home currency) leads to decrease foreign prices and increase imports. The latter tends to decrease the domestic price level or offset the imported inflation.

A one percentage point decrease in the exchange rate index in the initial period brings a decrease in demand for real imports of capital goods, of L.D. 3.365 million in the short run and L.D. 8.554 million in the long run. Demand for real imports of consumer goods is also decreased by L.D. 0.330 million and L.D. 8.425 million in the short and long runs, respectively. But these results are contrary to the economic theory where a decrease in the exchange rate in terms of home currency tends to reduce foreign prices and hence demand for real imports must increase assuming elastic demand. The reason for those wrong results is that the coefficient of the exchange rate in both import demand behavior equations has a wrong sign (positive). However when the slope of the demand for imports is corrected during the second half of the historical period, a negative sign is obtained. But the corrected coefficient is still positive so that positive changes in demand for (RMKP) are also obtained during the period (1971-1977) amounting to L.D. 30.160 million. Small negative changes are also obtained for (RMC) during the second half of the period. But overall net imports decreased by L.D. 4.945 million in the short run and L.D. 39.985 million in the long run. Concerning inflation a one percentage point decrease in the exchange rate leads to a decrease in the price level index of 0.020 in the first period and 0.204 in the long run. The decrease in the exchange rate tends also to increase real output in the private sector by L.D. 2.406 million in the short run and L.D. 143.433 million in the long run, because a decrease in the exchange rate must lead to an increase in imports of real capital goods which in turn leads to increase total output and worker's productivity. Real gross national product, in general, is also increased by L.D. 4.476 million and L.D. 196.757 million in the short and long runs respectively. The increase in RY combined with that decrease in the rate of inflation brings an increase in demand for money amounting to L.D. 1.239 million and L.D. 57.053 million in the short run and the long run, respectively. The money supply is also increased by L.D. 6.329 million in the short run and L.D. 51.171 million in the long run, resulting from an increase in the monetary base amounting to L.D. 4.945 million and L.D. 39.977million in the short and long runs, respectively, and the latter increase is a consequence of that increase in net foreign assets by a similar absolute amount, resulting from an equal amount of decrease in net imports. Therefore the effect of a change in the exchange rate on prices is partly offset by the increase in money supply, so that the reduction in the inflation rate is small, while the change in the rate of inflation in the housing sector turns out to be positive over all periods, because the effect of the money supply increase during the first period is stronger than that of the exchange rate on prices of the housing sector. Thus the same phenomenon of a backward shift in demand for investment in the housing sector mentioned above is also observed here. This is a consequence of a lower earnings which arose from those decreases in (Ph) during the period (1970-1977). The money multiplier is partly responsible for that increase in the money supply, as it shows a small increase resulting from a decrease in the currency-demand deposit ratio amounting to 0.0010 in the short run and 0.0603 in the long run. This small increase in the money multiplier is one fifth of the absolute decrease in the currency-demand deposit ratio. In general, it is important to note that most multipliers are increasing rather than diminishing during the historical period which suggests that the model is not stable. But it is likely to mention, once more, that the model is stable as indicated by the model simulation.

Net Earnings of Foreign Assets (NX)

Net exports in the balance of payments of the oil sector constitute the net earnings of the foreign assets which belongs wholly to the government. Therefore a one million dinar increase in (NX) means a similar increase in net foreign assets (Central Bank assets) and a similar increase in government deposits with the Central Bank (Central Bank liability). Economic activities in the non-oil sector may not be affected if the government does not start spending and the Central Bank does not tend to increase domestic credits because of that increase in its assets. But because the government is spending these earnings, the Central Bank is also increasing the monetary base by the same amount, as far as the change in (NFA) is equal to the change in (H). This is the reason why the multipliers of (NX) with respect to (NFA) and (H) are equal. Of interest is the fact that the effects of one million dinar increase in (NX) on economic activities is similar to that of one million dinar increase in claims on the government (CG) discussed above. The only difference is that the increase in (H) resulting from an increase in (NX) is covered by a similar change in net foreign assets while when (CG) or (CP) is increased by one million dinar, net foreign assets must decrease by an amount equal to that increase in net imports in the short run.

Ex-Post Forecasts for the Year 1978

Since it is possible to obtain data of all exogenous variables in the model even for one year (1978) after the historical period, it is preferable to perform an ex-post forecast for 1978 in order to investigate the model ability to predict accurate data outside the sample period. However it should be noted that the year 1978 is a transitional period for the application of the new socialist system derived from the green book of Colonel M. Qadhafi. That is to say, it is expected that some variables may have bad forecasts and hence it is not entirely fair to judge whether the model is able to predict acceptable accurate data or not, based only on this transitional year. Table XXIX summarizes the results of the ex-post forecasts. The percentage error of each endogenous variable is indicated in the last column. The negative signs indicate that the predicted value is greater than the actual value. These decreases in actual values compared to the predicted values, started by a decrease of 33.8 per cent in gross domestic product of the oil sector (OY) resulting from a 4.11 per cent decrease in the quantity of oil production and a 2.5 per cent decrease in the oil price index. Consequently, a decrease must occur in net foreign assets and the monetary base. This decrease accounted for 14.97 per cent in (NFA) and 16.84 per cent in (H). The latter decrease is reflected wholly in the money supply. Therefore this decrease combined with that decrease of 5.82 per cent in the

TABLE XXIX

EX-POST FORECASTS FOR THE YEAR 1978

Dep. variable	Actual	Predicted	$(Y-\hat{Y})/Y$ %
RM1	627.4	504.3	19.63
P	2.690	2.676	0.52
Ph	4.107	3.110	24.27
(CC/DD)	1.060	0.7126	32.77
(R/DD)	0.2776	0.2702	2.64
OY [1]	2777.	3717.	-33.84
RYP [1]	976.0	593.7	39.17
RMKP	256.6	192.2	25.09
RMC	236.0	217.6	7.79
RM	0.2442	0.2378	2.64
RS	0.5628	0.1835	67.40
MU1	1.245	1.317	- 5.82
MS1	1688.0	2087.0	-23.64
MX1	37.67	46.58	-23.64
GDP [1]	5403.	5306.	1.79
Y [1]	5073.	4976.	1.91
RY [1]	1886.	1860.	1.40
NM	2119.	1891.	10.77
NFA	1526.	1754.	-14.97
H	1356.	1584.	-16.84

(1) Revised data from: Central Bank of Libya: Annual Report 1979, TRIPOLI, The Socialist People's Libyan Arab Jamahiriya.

Note: P, Ph are index numbers, Jan. 1964 = 1.00, MX1 is index number of MS1 taking 1964 as a base, MU1 is a multiplier number, (CC/DD) and (R/DD) are ratios, while the rest of the variables are in L.D. million.

money multiplier produce a higher decrease amounting to 23.64 per cent in the money supply. The increase of 32.77 per cent in the currency-demand deposit ratio is mostly responsible for that decrease in the money multiplier. In fact the government actions taken in this year are responsible for discouraging people to hold bank deposits, and hence the preference of holding currency is observed so that currency outside banks increased by 48.5 per cent in 1978, while demand deposits showed a decrease of 4.6 per cent in the same year. This is why actual demand for money is also greater than the predicted one. Other weak forecasts are performed with respect to Ph, RYP and RMKP, but it is expected that their data are still primary and not accurate, especially the price index of housing does not represent the whole year, as it is only for the first quarter. In fact, this price index is not available any more since building houses for rent is prohibited by law. According to the Green Book, "In need freedom is latent", that is, a free man must own the house in which he lives so that there is no one else who may control his primary need, and move him out if he becomes unable to pay the rent.

However, nine endogenous variables have reasonable forecasts especially the gross national product in both nominal and real terms, as the percentage error is less than two per cent. The reader may also compare these results with those results of forecasts (with primary estimates of Y) shown in Table XXIV and XXV.

Thus on the whole, some equations do not perform as well as expected, while other equations perform a good forecast beyond the estimation period; hence the model can be used for future forecasting when the transitional periods are over.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The Complete Model

In Libya, and in other oil producing countries as well, oil revenue is by far the principal source of gaining foreign exchange for financing imports of goods and services and hence economic development in general. Therefore with a 90-100 per cent backing by gold and foreign exchange of the currency issued, the money supply can be expected to reflect those changes in the net foreign assets which are shown in the balance of payments. The impact of oil revenues in the money supply and the consequent effects on the economy is understandable topics for research. Thus a monetary macroeconometric model is constructed in this study, which is developed in Chapter IV. This model is based on annual data during the period (1962-1977). The model contains twenty-one equations, of which nine are behavioral equations. The model is estimated by the ordinary least squares (OLS) method in Chapters V and VI, and by the two-stage least squares (2SLS) method in Chapter VII. The complete model was tested for stability and its predictive ability was examined in Chapter VIII. The role of money in economic activity is also investigated in the previous chapter. Most results which were obtained supported the model's stability and predictive ability, and the major role of money in the Libyan economic activities. However, most of the total dynamic multipliers were not finite, which suggest that the model is not stable. But Chow's test supported the stability of the nine behavioral equations, and the performance of the dynamic simulation supported the model's stability during the period (1963-1971), as the dynamic simulation diverges only in 1972. A sensitivity test of the complete model was made. This test indicated that there were only three sensitive variables, namely: the currency-demand deposit ratio, the opportunity cost of holding money and the rental price of money substitutes. Thus, in general, the complete model was insensitive to changing periods, hence it represented the real world during the whole historical period. The importance of the complete model was not only to demonstrate the role of money in economic activity, but also to demonstrate the linkage among the three main economic sectors, namely, the money sector, the real sector, and the foreign sector which is summarized in the balance of payments. It was found also that the complete model is superior to the Johnson's (37, p. 156) single equation model in the case of Libya based on the criterion of the level of the mean absolute percentage error arose in predicting the value of net foreign assets.

Demand for Money

The demand for money function was estimated in Chapter V using annual data and quarterly data. The function was also disaggregated into demand for currency and demand for demand deposits. Analysis by period was also made to investigate the behavioral equations before and after the First of September (1969) Revolution. It is found that those regressions estimated with annual data are more accurate than those estimated with quarterly data. This is as a result of our limitation that the quarterly data of real income and real development expenditures are interpolated as they are not available on the quarterly basis. It is found also that most independent variables which are relevant in the whole period, are also relevant during the second period (1969-1977). While demand for money in the first period (1962-1969) is sensitive only to real income and the lagged dependent variable when annual data are used, and to real income and real development expenditures when the quarterly data are used.

Concerning analysis by period, the money demand function estimated during the whole period is still preferable. But if forecasting is needed before or after this period, then it is recommended that the equations of the first period for back casting be used, and equations of the second period for future forecasting be used. The empirical evidence of the demand for real money in Libya has tended to favor the asset demand for money. When this function is disaggregated, the demand for real currency becomes a transaction demand model and demand for real demand deposits is an asset demand model. This suggests that the latter function is dominating the demand function for real money. This is the most important piece of information being gained from analyzing a disaggregated model.

Concerning the income elasticity of money, using annual data, the classical unitary income elasticity of money demand holds in Libya, except that the income elasticity of demand for real currency which is found statistically not different from one half, suggesting that demand for real currency belongs to the "transactional model." The income elasticity of demand for real time and saving deposits is 2.0 and statistically is different from one. This high level of income elasticity suggests that these deposits are 'superior goods' in Libya. But using quarterly data, the classical unitary income elasticity of money demand (aggregated and disaggregated) holds in Libya regardless of the definition of money. When the whole period is broken into two shorter periods most income elasticities become lower than for the period as a whole. By using quarterly data, the income elasticity of demand for money narrowly defined is not statistically different from one half (aggregated or disaggregated) during the two separate periods. While the income elasticity of demand for money broadly defined is statistically different from one in the first period and not different from one in the second period. In general the income elasticities estimated with quarterly data are less than those estimated with annual data. It is found also that demand for real demand deposits, real currency, and real money narrowly defined, in general, is more sensitive to changes in the opportunity cost of holding money, than that for more conclusive money. Thus the inclusion of time and saving deposits are poor money substitute while currency is definitely a very good money substitute, followed by demand deposits.

Money, Prices and Income

The equations for the currency-deposit ratio and the reserve-deposit ratio, affecting the money supply, are well specified. The estimation of money supply yielded a mean absolute percentage error (MAPE) of 5.118 per cent when the complete model is concerned and only 1.751 per cent when the reduced model (no foreign sector) is concerned. The money supply, as a proxy for the effective demand for goods and services, is found to have a considerable impact on prices and nominal incomes and a negligible effect on real incomes. That is, the effective demand is mostly met by the imports of goods and services. It is found that the domestic production is relatively sensitive to changes in the money supply. In fact the considerable change in money supply is coming from a change in the monetary base so that the latter change whether it comes from the government sources or from the monetary sources, may have a similar effect on economic activities.

A comparison between predicted values of demand for and supply of nominal money was made. It is found that there is a (MAPE) of 8.0 per cent or a mean percentage error of 4.4 per cent between the predicted values during the period (1963-1977). But of interest is the fact that the average predicted values of demand for and supply of nominal money are exactly equal (L.D. 432.1 million) during the mentioned period. Thus these indications suggest that the Harry Johnson's assumption of equality between demand for and supply of nominal money is reasonable in the case of Libya, especially when the period becomes longer.

The equations for prices were also well specified and yield a MAPE of 2.179 per cent in the case of the general price level and 4.183 per cent in the case of the housing prices. They are also well associated with the theoretical views concerning prices. That is, the general price level is influenced by the imported inflation, the domestic inflation, and the demand-pull inflation, while the housing price level (domestic inflation) is influenced also by the imported inflation in this sector, and by the wage-push and demand-pull inflations. The results suggest that the subsidies paid by the government to main items of foodstuffs are effective in reducing the effects of the imported inflation during the period (1971-1977).

Concerning the price effect on the output, it is assumed that such effect is absent in the oil sector as its production is mostly sold in terms of dollars, and is present in the non-oil sector. Therefore, the oil gross domestic product is found to be very sensitive to the quantity of oil production, the price index of oil exports in terms of dollars and the exchange rate index of dollars in terms of home currency. The oil output elasticity is unitary with respect to each of these three variables. While the non-oil output elasticity is only one half with respect to either real wage and foreign-domestic prices ratio, and unitary with respect to the foreign exchange index in terms of home currency. Thus the non-oil output is weakly sensitive to prices since the foreign supply of goods and services is faster to be adjusted to the country's effective demand. But it is likely to note here that the real wage variable has a wrong positive sign, which is contrary to the theoretical view. This wrong sign is also obtained when the analysis by period is concerned. The model simulation yields a MAPE of less than five percent in total gross domestic product, and gross national product in both nominal and real terms. Thus the model has a higher ability to predict the values of gross national product in the Libyan economy.

The Balance of Payments

According to the simulation, the predicted values of real expenditures on imports of capital goods and consumer goods yields a MAPE of 8.340 per cent and 3.616 per cent respectively, while their nominal values including net imports of services (net imports of goods and services), yield a MAPE of only 2.668 per cent. The predicted value of net foreign assets yields a MAPE of 2.831 per cent. Therefore the complete model has a higher ability to predict the main endogenous variables in the balance of payments, consequently, a surplus or deficit in the balance of payments is reflected in money supply, since the latter is linked to the balance of payments through the monetary base identity. Thus money supply has a considerable influence on the balance between income and expenditure in the balance of payments.

The equation for real imports of capital goods yields a wrong negative sign for the ratio of wage to foreign prices of capital goods variable and a wrong positive sign for the exchange rate variable. This suggests that Libyan importers are not sensitive to changes in these two variables. This result is to be expected, since most imports of capital goods were imported by the public sector with the aim of economic development and not for the aim of profit-making. Concerning the analysis by period the correct positive sign of the wage-price ratio variable is obtained in each period. While the exchange rate variable is still with an incorrect sign. But the coefficient of these variables are not significant. The elasticity of real imports of capital goods is about 2.0 with respect to gross domestic product in the non-oil sector, while the propensity to import capital goods is 0.8.

The equation for real imports of consumer goods yields also a wrong positive sign for both the foreign-domestic price ratio variable and the exchange rate variable, even though the latter is not significant. This is also suggesting that Libyan importers of consumer goods are not sensitive to these two variables. This result may be accepted in a case where a large part of imported foodstuffs is subsidized by the government on one hand, and importers are able to sell these goods at profitable prices on the other, since demand for these goods exceeds their supply. However, when the analysis by period is concerned, the correct sign for the price ratio is obtained during the first period which is associated with the theoretical view. But during the second period, the equation for real imports of consumer goods has the same characteristics of the equation estimated during the whole period. The elasticity of real imports of consumer goods is 0.3 with respect to real gross national product. It is not statistically different from one half, while the price ratio elasticity is 0.8 and it is not statistically different from one. The average tariff rate elasticity is also one half and very significant. But the propensity to import consumer goods is 0.09 during the period under discussion.

The Policy Variables

There are four policy variables considered in this study. Three are monetary policy instruments, namely: claims on the government (CG), claims on the private sector (CP) and the exchange rate (E). The other policy variable is the foreign exchange earning by the government, represented by the net exports (NX) of the oil sector in the balance of payments. Since the foreign exchange earnings of the government are deposited immediately at the Central Bank of Libya and become a part of the monetary base identity, it is found that an increase of one million dinar in CG, or CP, or NX has the same effect on economic activities, that is because the economic development in Libya depends largely on the foreign sector. But the monetary base is not wholly controlled by the monetary authority, as it is influenced largely by fiscal policy. Therefore the cooperation of the fiscal authorities with the monetary authority is a necessary condition for making the monetary policy tools more effective. The exchange rate is found to be an effective tool of monetary policy in increasing production, and it has a reasonable effect in curbing inflation, even though it is not directly.

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APPENDIX A

LIST OF VARIABLES

APPENDIX A

LIST OF VARIABLES

AGR	The moving average of changes in (R)
CC	Currency outside banks
CP	Claims on private sectors (Central Bank)
CG	Claims on government (Central Bank)
DCO	Deposits of private sector at the commercial banks
DRLP	Change in real credits granted to the public
$\frac{DC}{DD}$	The ratio of private deposits with the Central Bank (DC) to demand deposits of the public
E	Exchange rate index (1964 = 1.00) in terms of home currency
ES	Exchange rate index of dollars in terms of home currency (1964 = 1.00)
FY	Foreign factor's income
GDP	Gross domestic product = OY + YP
GR	The growth rate of reserves (R)
H	The monetary base (H = R + CC + DC)
IM	Imports of goods in the non oil sector
IT	Indirect taxes
L	Labor
LP	Total credits to private sector (monthly average)
LR	Legal reserve requirement ratio (monthly average)
M1	Money narrowly defined = DD + CC
M2	Money broadly defined (M2 = M1 + TS)

MS1	Money supply = M1
MX1	An index of money supply (1964 = 1.00)
m1	Money multiplier $\frac{M1}{H}$
MC	Imports of consumer goods (MC = IM - MKP)
MKP	Imports of producer goods to the non-oil sector
NFA	Net foreign assets (central and commercial banks)
NK	Net capital outflow in the non-oil sector (NOS)
NL	Net liabilities of the Central Bank (other items net)
NM	Net imports of goods and services in (NOS)
NS	Net services and non-oil exports in (NOS)
NX	Net surplus of the oil sector in the balance of payments (net exports of goods and services plus net capital flow)
OPX	Oil price index in terms of dollars (1964 = 1.00)
OY	Gross domestic product in the oil sector
P	The general price level, consumer price index, January 1964 = 1.00
PB	Price index of imports of building material in terms of foreign currency (1964 = 1.00)
Ph	Price index of rents and prices of houses and building materials (Jan. 1964 = 1.00)
PK	Price index of imports of producer goods in terms of foreign currency (1964 = 1.00)
PMC	Price index of imports of consumer goods in terms of foreign currency (1964 = 1.00)
PWB	Price index of imports of building materials in terms of home currency (1964 = 1.00)
PWC	Price index of imports of consumer goods in terms of home currency (1964 = 1.00)
PWK	Price index of imports of producer goods in terms of home currency (1964 = 1.00)
QX	Quantity of oil produced

R	Reserves of commercial banks (deposits with the Central Bank plus their Vault cash)
rdl (rd2)	The competitive rate of interest paid on demand deposits (total deposits)
RG	Actual real development expenditures spent by the government
RM	The opportunity cost of holding money (the inflation rate)
rs	The rate of interest on time and savings deposits
Rs	The rental price of money substitute
RY	Real gross national product
S	Subsidies paid by the government
TD	total deposit liabilities of banks to the public
TDCO	Total deposit liabilities of commercial banks to the public
Tr	Average rate of tariff = $\left(\frac{TX}{MC} \right)$
TS	Time and savings deposits
TX	Total taxes on imports
W	Average nominal wage = $\left(\frac{WS}{L} \right)$
WS	Wages and salaries (component of GNP)
WY	The ratio of (WS) to (Y) $\therefore WY = \frac{WS}{Y}$
WYP	The ratio of (WS) to (YP) $\therefore WYP = \frac{WS}{YP}$
Y	Gross national product at current prices
YP	Gross domestic product in the non-oil sector

List of Dummy Variables

DR	Denotes uncertainty affecting demand for money, DR = 1 for years greater than 1969 and zero otherwise
D76	Denotes uncertainty affecting demand for money, D76 = 1 for 1976 and 1977 and zero otherwise

DV	Denotes big increase in development expenditures, DV = 1 for years greater than 1970 and zero otherwise
Dh	Denotes government actions in the housing sector, Dh = DV
DE	Denotes big changes in the exchange rate and the exchange rate floating DE = DV
DS	Denotes subsidies to some consumer commodities, DS = DV

Notes:

1 - When R is a prefix to the variable, it denotes the real value

2 - When L is a prefix to the variable, it denotes the log

3 - When one is added to the variable, it denotes that variable is lagged one period

APPENDIX B

STATIC SIMULATION (REDUCED MODEL)

1 - (RM1) DEMAND FOR REAL BALANCES (THE REDUCED MODEL)

```
COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
**********************************************

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT =     .9935                              (SQUARED =     .9870     )

ROOT-MEAN-SQUARED ERROR =     24.54

MEAN ABSOLUTE ERROR =    19.33

MEAN ERROR =     2.108

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED =     1.022

THEIL'S INEQUALITY COEFFICIENT =     .3646D-01

FRACTION OF ERROR DUE TO BIAS =     .7381D-02

FRACTION OF ERROR DUE TO DIFFERENT VARIATION =     .5790D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION =     .9347

ALTERNATIVE DECOMPOSITION  (LAST 2 COMPONENTS):

     FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY =     .3411D-01

     FRACTION OF ERROR DUE TO RESIDUAL VARIANCE =     .9585


                    PLOT OF ACTUAL(*) AND FITTED(+) VALUES                 PLOT OF RESIDUALS(0)

                                                                  RESIDUAL
ID  ACTUAL     FITTED                                                            0.0
 2   32.39      34.29   +                                           -1.90    .    0.      .
 3   42.82      41.39    +                                           1.43    .    0       .
 4   60.00      52.27     +                                          7.73    .     . 0    .
 5   71.93      66.93      +                                         5.00    .     .0     .
 6   86.71      83.07       +                                        3.65    .     .0     .
 7   111.6      126.6         *+                                    -15.0    .  0  .      .
 8   135.8      143.5           *+                                  -7.75    .   0 .      .
 9   153.2      176.9           *  +                                -23.7    0     .      .
10   238.7      214.1                + *                             24.6    .     .      0
11   269.8      238.1                  + *                           31.7    .     .      . 0
12   313.4      334.0                      *+                       -20.5    .0    .      .
13   425.2      451.2                           * +                 -25.9    0     .      .
14   449.8      477.9                            * +                -28.2   0.     .      .
15   562.1      577.0                                 *+            -14.9    .  0  .      .
16   667.9      629.7                                    +  *        38.1    .     .      .  0
17   627.4      568.2                                 +  *           59.3    .     .      .      0
```

2 - (P) THE PRICE LEVEL (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9934 (SQUARED = .9869)

ROOT-MEAN-SQUARED ERROR = .5330D-01

MEAN ABSOLUTE ERROR = .3780D-01

MEAN ERROR = .1199D-01

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.073

THEIL'S INEQUALITY COEFFICIENT = .1777D-01

FRACTION OF ERROR DUE TO BIAS = .4228D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .2957

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .6620

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2453

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .7124

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT	RESIDUAL	PLOT OF RESIDUALS (0.0)
2	1.041	1.028	+	.128E-01	. .0 .
3	1.047	1.095	*+	-.484E-01	.0 . .
4	1.112	1.190	* +	-.780E-01	0 . . .
5	1.264	1.275	+	-.113E-01	. 0. .
6	1.348	1.338	+	.981E-02	. .0 .
7	1.346	1.315	+*	.306E-01	. . 0 .
8	1.487	1.480	+*	.735E-02	. .0 .
9	1.574	1.499	+ *	.754E-01	. . .0
10	1.527	1.520	+	.688E-02	. .0 .
11	1.531	1.538	+	-.687E-02	. 0 .
12	1.640	1.627	+	.135E-01	. .0 .
13	1.773	1.773	+	-.409E-03	. 0 .
14	1.929	1.893	+*	.356E-01	. . 0 .
15	2.027	2.002	+	.248E-01	. . 0 .
16	2.162	2.223	* +	-.615E-01	0 . .
17	2.690	2.509	+ *	.181	. . . 0

3 - (Ph) THE PRICE LEVEL OF HOUSING (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9700 (SQUARED = .9408)

ROOT-MEAN-SQUARED ERROR = .2328

MEAN ABSOLUTE ERROR = .1260

MEAN ERROR = .6657D-01

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.175

THEIL'S INEQUALITY COEFFICIENT = .5694D-01

FRACTION OF ERROR DUE TO BIAS = .8178D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .3499

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .5683

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2399

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .6783

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	1.011	1.020	-.944E-02
3	1.075	1.091	-.159E-01
4	1.135	1.236	-.101
5	1.429	1.364	.648E-01
6	1.744	1.507	.237
7	1.625	1.678	-.529E-01
8	1.866	1.933	-.670E-01
9	1.394	1.376	.182E-01
10	1.480	1.552	-.716E-01
11	1.635	1.632	.280E-02
12	2.145	2.043	.102
13	2.397	2.377	.197E-01
14	2.724	2.833	-.109
15	2.740	2.472	.268
16	2.628	2.676	-.485E-01
17	4.107	3.278	.829

4 – $(\frac{CC}{DD})$ DEMAND FOR CURRENCY-DEMAND DEPOSIT RATIO (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .8414 (SQUARED = .7079)

ROOT-MEAN-SQUARED ERROR = .1284

MEAN ABSOLUTE ERROR = .91230-01

MEAN ERROR = .18220-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9841

THEIL'S INEQUALITY COEFFICIENT = .73270-01

FRACTION OF ERROR DUE TO BIAS = .20130-03

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .71940-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9279

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .63400-03

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9992

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	1.118	1.160	-.421E-01
3	1.216	1.218	-.177E-02
4	1.014	1.042	-.276E-01
5	1.104	1.003	.101
6	1.091	.9180	.173
7	.8816	.8776	.397E-02
8	1.029	1.090	-.612E-01
9	.8714	.9116	-.402E-01
10	.4950	.6063	-.111
11	.5549	.7030	-.148
12	.6505	.8029	-.152
13	.5332	.6495	-.116
14	.6634	.6647	-.130E-02
15	.6198	.6328	-.130E-01
16	.6811	.5820	.991E-01
17	1.060	.6931	.367

5 - $(\frac{R}{DD})$ DEMAND FOR RESERVE-DEMAND DEPOSIT RATIO (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9545 (SQUARED = .9110)

ROOT-MEAN-SQUARED ERROR = .2173D-01

MEAN ABSOLUTE ERROR = .1727D-01

MEAN ERROR = .2921D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.025

THEIL'S INEQUALITY COEFFICIENT = .3399D-01

FRACTION OF ERROR DUE TO BIAS = .1807D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .5130D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9306

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .5731D-02

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9762

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	PLOT	RESIDUAL
2	.4020	.3622	+ *	.399E-01
3	.2570	.3036	* +	-.466E-01
4	.4257	.3935	+ *	.322E-01
5	.3771	.3483	+ *	.288E-01
6	.4097	.4025	+ *	.725E-02
7	.3168	.3210	*+	-.420E-02
8	.2181	.2417	* +	-.236E-01
9	.2708	.2603	+ *	.105E-01
10	.3749	.3884	* +	-.136E-01
11	.4070	.4281	* +	-.211E-01
12	.2132	.2175	*+	-.427E-02
13	.2997	.3012	+	-.149E-02
14	.2715	.2631	+ *	.842E-02
15	.2604	.2515	+ *	.887E-02
16	.2337	.2153	+ *	.184E-01
17	.2776	.2702	+ *	.732E-02

6 - (OY) PRODUCTION FUNCTION IN THE OIL SECTOR (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9934 (SQUARED = .9869)

ROOT-MEAN-SQUARED ERROR = 156.2

MEAN ABSOLUTE ERROR = 91.90

MEAN ERROR = -37.79

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9226

THEIL'S INEQUALITY COEFFICIENT = .4638D-01

FRACTION OF ERROR DUE TO BIAS = .5855D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .2771

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .6643

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

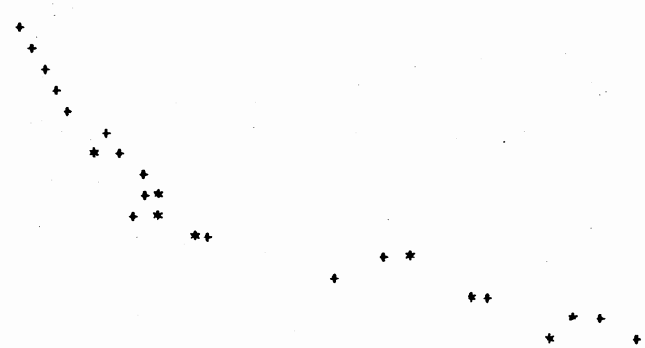
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .3265

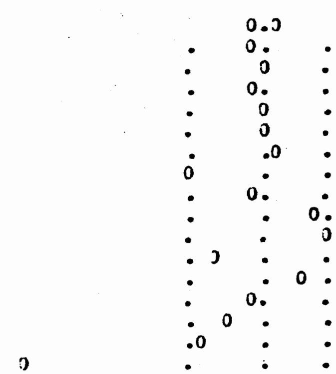
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .6150

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	99.60	101.8	-2.24
3	195.7	194.8	.851
4	270.1	282.5	-12.4
5	356.1	347.3	8.80
6	402.5	398.2	4.27
7	648.6	598.6	50.0
8	547.7	709.0	-161.
9	812.6	825.9	-13.3
10	922.1	807.0	115.
11	916.0	772.7	143.
12	1125.	1224.	-99.6
13	2375.	2264.	111.
14	1961.	1971.	-9.94
15	2750.	2835.	-85.2
16	3350.	3471.	-121.
17	3185.	3717.	-532.





7 - (RYP) PRODUCTION FUNCTION IN THE NON-OIL SECTOR (THE REDUCED MODEL)

```
COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
**********************************************

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT =     .9584                        (SQUARED =    .9186    )

ROOT-MEAN-SQUARED ERROR =     93.65

MEAN ABSOLUTE ERROR =    44.29

MEAN ERROR =    22.66

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED =    1.019

THEIL'S INEQUALITY COEFFICIENT =    .7801D-01

FRACTION OF ERROR DUE TO BIAS =    .5857D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION =    .4013D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION =    .9013

ALTERNATIVE DECOMPOSITION  (LAST 2 COMPONENTS):

     FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY =    .3502D-02

     FRACTION OF ERROR DUE TO RESIDUAL VARIANCE =    .9379

                    PLOT OF ACTUAL(*) AND FITTED(+) VALUES                    PLOT OF RESIDUALS(O)

ID   ACTUAL     FITTED                                                     RESIDUAL
                                                                                        0.0
 2   130.4      134.8   +                                                   -4.41     .    O    .
 3   161.3      165.2    +                                                  -3.89     .    O    .
 4   199.6      186.4     +*                                                 13.3     .    .O   .
 5   220.6      220.9      +                                                -.357     .    O    .
 6   256.2      249.5       +*                                               6.68     .    O    .
 7   315.0      355.7          *  +                                         -40.7     .  O .    .
 8   454.1      408.0            +  *                                        46.1     .    .  O .
 9   302.2      323.9         *+                                            -21.6     .   O.    .
10   435.1      433.5             +                                          1.65     .    O    .
11   546.7      482.5              +   *                                     64.2     .    .   O.
12   644.8      686.6                      * +                              -41.8     .  O .    .
13   845.3      883.9                              * +                      -37.6     .  O .    .
14   888.1      898.7                               *+                      -10.6     .   O.    .
15   995.6      1008.                                   *+                  -12.1     .   O.    .
16   1074.      1025.                                    +  *                49.0     .    .  O .
17   948.5      593.7                  +               *                     355.     .    .    .      O
```

8 - (RMKP) DEMAND FOR REAL IMPORTS OF CAPITAL GOODS (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9771 (SQUARED = .9547)

ROOT-MEAN-SQUARED ERROR = 21.63

MEAN ABSOLUTE ERROR = 12.47

MEAN ERROR = 4.859

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.038

THEIL'S INEQUALITY COEFFICIENT = .6994D-01

FRACTION OF ERROR DUE TO BIAS = .5049D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .6971D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8798

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2577D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9237

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	PLOT	RESIDUAL	PLOT (0.0)
2	27.62	30.86	*+	-3.24	. O. .
3	33.38	33.63	+	-.256	. O .
4	39.84	34.52	+*	5.31	. . O .
5	53.01	49.01	+*	4.00	. .O .
6	43.09	46.51	+	-3.42	. O. .
7	55.03	58.30	*+	-3.27	. O. .
8	57.32	57.60	+	-.279	. O .
9	38.86	40.20	+	-1.34	. O .
10	64.25	80.61	* +	-16.4	.O . .
11	109.7	93.08	+ *	16.6	. . O.
12	176.3	181.3	*+	-4.98	. O. .
13	253.6	205.6	+ *	48.0	. . . O
14	300.0	299.6	+	.364	. O .
15	242.6	256.7	* +	-14.1	. O . .
16	242.1	255.8	* +	-13.7	. O . .
17	256.6	192.2	+ *	64.4	. . . O

9 - (RMC) DEMAND FOR REAL IMPORTS OF CONSUMER GOODS (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9970 (SQUARED = .9939)

ROOT-MEAN-SQUARED ERROR = 6.241

MEAN ABSOLUTE ERROR = 4.601

MEAN ERROR = .8196

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.017

THEIL'S INEQUALITY COEFFICIENT = .22090D-01

FRACTION OF ERROR DUE TO BIAS = .1725D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .5854D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9242

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4168D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9411

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT	RESIDUAL	RESIDUAL PLOT (0.0)
2	30.86	30.30	+	.566	. .0 .
3	39.48	39.36	+	.122	. 0 .
4	43.46	46.56	*+	-3.10	. 0 . .
5	50.28	48.23	+	2.05	. . 0 .
6	59.61	57.41	+	2.19	. . 0 .
7	74.70	73.21	+*	1.49	. . 0 .
8	68.57	71.08	*+	-2.51	. 0 . .
9	66.67	69.71	*+	-3.04	. 0 . .
10	86.98	84.55	+	2.43	. . 0 .
11	102.6	97.56	+*	5.00	. . 0.
12	144.1	155.5	* +	-11.4	0 . . .
13	198.9	196.2	+*	2.73	. . 0 .
14	229.4	226.2	+*	3.27	. . 0 .
15	215.4	225.6	* +	-10.2	0 . . .
16	253.5	245.5	+ *	8.06	. . .0
17	235.0	220.6	+ *	15.4	. . . 0

10 - (RM) THE RATE OF INFLATION (THE REDUCED MODEL)

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COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
**********************************************

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT =    .8261                        (SQUARED =    .6824    )

ROOT-MEAN-SQUARED ERROR =    .3520D-01

MEAN ABSOLUTE ERROR =    .2476D-01

MEAN ERROR =    .3975D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED =    .9209

THEIL'S INEQUALITY COEFFICIENT =    .2011

FRACTION OF ERROR DUE TO BIAS =    .1275D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION =    .3241D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION =    .9548

ALTERNATIVE DECOMPOSITION  (LAST 2 COMPONENTS):

     FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY =    .1542D-01

     FRACTION OF ERROR DUE TO RESIDUAL VARIANCE =    .9718

                      PLOT OF ACTUAL(*) AND FITTED(+) VALUES                        PLOT OF RESIDUALS(O)

ID   ACTUAL       FITTED                                                   RESIDUAL
                                                                                           0.0
  2   .6660E-01   .5346E-01            +  *                                 .131E-01     .    . O    .
  3   .5764E-02   .5227E-01        *       +                               -.465E-01   O .    .      .
  4   .6208E-01   .1366                     *           +                  -.745E-01 O   .    .      .
  5   .1367       .1468                                 * +                -.101E-01     .   O.      .
  6   .6646E-01   .5869E-01             + *                                 .776E-02     .    .O     .
  7  -.1484E-02  -.2422E-01    +   *                                        .227E-01     .    .   O  .
  8   .1048       .9930E-01                      +*                         .546E-02     .    .O     .
  9   .5851E-01   .7786E-02        +        *                               .507E-01     .    .      . O
 10  -.2986E-01  -.3423E-01 +*                                              .437E-02     .    .O     .
 11   .2619E-02   .7116E-02       *+                                       -.450E-02     .    O      .
 12   .7120E-01   .6239E-01              + *                                .880E-02     .    . O    .
 13   .8110E-01   .8135E-01                *                               -.249E-03     .    O      .
 14   .8799E-01   .6794E-01              +   *                              .201E-01     .    .  O   .
 15   .5080E-01   .3792E-01          + *                                    .129E-01     .    . O    .
 16   .6660E-01   .9693E-01              +    +                            -.303E-01     .O   .      .
 17   .2442       .1603                                   +        *        .839E-01     .    .      .      O
```

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11 - (RS) THE RENTAL PRICE OF MONEY SUBSTITUTE (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .8371 (SQUARED = .7007)

ROOT-MEAN-SQUARED ERROR = .1003

MEAN ABSOLUTE ERROR = .6419D-01

MEAN ERROR = .2586D-01

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.119

THEIL'S INEQUALITY COEFFICIENT = .2772

FRACTION OF ERROR DUE TO BIAS = .6651D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .1927

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .7407

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2404D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9094

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT OF ACTUAL(*) AND FITTED(+)	RESIDUAL	PLOT OF RESIDUALS(0) (0.0)
2	.6871E-01	.7869E-01	+	-.998E-02	. 0. .
3	.6330E-01	.7907E-01	*+	-.158E-01	. 0. .
4	.5581E-01	.1500	* +	-.942E-01	0 . .
5	.2590	.2019	+ *	.571E-01	. . 0 .
6	.2204	.5440E-01	+ *	.166	. . . 0
7	-.6823E-01	-.3790E-01	*+	-.303E-01	. 0 . .
8	.1483	.1895	* +	-.412E-01	. 0 . .
9	-.2529	-.2627	+*	.977E-02	. 0 .
10	.6169E-01	.1131	* +	-.514E-01	. 0 . .
11	.1047	.1028	+	.189E-02	. 0 .
12	.3119	.2498	+ *	.621E-01	. . 0 .
13	.1175	.1083	+*	.916E-02	. 0 .
14	.1364	.1818	* +	-.454E-01	. 0 . .
15	.5874E-02	-.9233E-01	+ *	.982E-01	. . 0.
16	-.4088E-01	-.2319E-01	*+	-.177E-01	. 0. .
17	.5628	.2474	+ *	.315	. . . 0

12 - (MU1) THE MONEY MULTIPLIER (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9470 (SQUARED = .8969)

ROOT-MEAN-SQUARED ERROR = .3135D-01

MEAN ABSOLUTE ERROR = .2503D-01

MEAN ERROR = -.4462D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .8296

THEIL'S INEQUALITY COEFFICIENT = .1277D-01

FRACTION OF ERROR DUE TO BIAS = .2026D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .1392

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8405

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2630

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .7168

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	1.257	1.281	-.233E-01
3	1.262	1.229	.328E-01
4	1.156	1.175	-.189E-01
5	1.162	1.192	-.297E-01
6	1.090	1.104	-.136E-01
7	1.151	1.148	.259E-02
8	1.149	1.130	.196E-01
9	1.208	1.211	-.269E-02
10	1.159	1.135	.236E-01
11	1.123	1.096	.270E-01
12	1.279	1.245	.331E-01
13	1.277	1.251	.259E-01
14	1.288	1.296	-.816E-02
15	1.373	1.379	-.618E-02
16	1.373	1.429	-.562E-01
17	1.245	1.322	-.773E-01

13 - (MS1) MONEY SUPPLY (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9993 (SQUARED = .9986)

ROOT-MEAN-SQUARED ERROR = 30.73

MEAN ABSOLUTE ERROR = 14.46

MEAN ERROR = -8.099

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9567

THEIL'S INEQUALITY COEFFICIENT = .2105D-01

FRACTION OF ERROR DUE TO BIAS = .6948D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .5437

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .3868

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .5604

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .3702

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT	RESIDUAL	PLOT OF RESIDUALS (0.0)
2	33.57	34.19	+	-.622	. 0. .
3	44.79	43.63	+	1.16	. 0 .
4	66.70	67.79	+	-1.09	. 0. .
5	90.90	93.22	+	-2.32	. 0. .
6	116.8	118.2	+	-1.45	. 0. .
7	150.2	149.9	+	.338	. 0 .
8	201.7	198.2	+	3.44	. 0 .
9	241.1	241.6	+	-.536	. 0. .
10	364.5	357.1	+	7.42	. .0 .
11	413.0	403.1	+*	9.92	. .0 .
12	514.0	500.7	+	13.3	. . 0 .
13	753.9	738.6	+	15.3	. . 0 .
14	867.5	873.0	+	-5.50	. 0. .
15	1139.	1145.	+	-5.13	. 0. .
16	1444.	1503.	* +	-59.1	0 . . .
17	1688.	1793.	* +	-105.	0 . . .

14 – (MX1) INDEX NUMBER OF MONEY SUPPLY (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9993 (SQUARED = .9986)

ROOT-MEAN-SQUARED ERROR = .6856

MEAN ABSOLUTE ERROR = .3225

MEAN ERROR = -.1790

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9567

THEIL'S INEQUALITY COEFFICIENT = .2104D-01

FRACTION OF ERROR DUE TO BIAS = .6818D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .5443

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .3875

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .5610

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .3708

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	RESIDUAL
2	.7527	.7632	-.105E-01
3	1.001	.9738	.269E-01
4	1.489	1.513	-.239E-01
5	2.030	2.081	-.512E-01
6	2.609	2.639	-.303E-01
7	3.354	3.345	.896E-02
8	4.507	4.425	.818E-01
9	5.383	5.393	-.981E-02
10	8.137	7.970	.166
11	9.219	8.997	.222
12	11.47	11.18	.298
13	16.83	16.49	.343
14	19.37	19.49	-.120
15	25.43	25.55	-.112
16	32.23	33.55	-1.32
17	37.67	40.01	-2.34

15 - (GDP) GROSS DOMESTIC PRODUCT (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9956 (SQUARED = .9933)

ROOT-MEAN-SQUARED ERROR = 158.4

MEAN ABSOLUTE ERROR = 89.03

MEAN ERROR = 31.16

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.019

THEIL'S INEQUALITY COEFFICIENT = .2778D-01

FRACTION OF ERROR DUE TO BIAS = .3868D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .6819D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8931

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4924D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9121

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT	RESIDUAL	PLOT OF RESIDUALS (0.0)
2	235.3	240.4	+	-5.10	. 0. .
3	364.6	375.8	+	-11.2	. 0. .
4	492.1	504.3	+	-12.2	. 0. .
5	634.9	629.0	+*	5.86	. 0 .
6	747.8	732.1	+*	15.7	. 0 .
7	1073.	1066.	+	6.13	. 0 .
8	1223.	1313.	*+	-89.8	. 0 . .
9	1288.	1311.	*+	-23.0	. 0. .
10	1586.	1466.	+*	121.	. . 0.
11	1753.	1515.	+ *	238.	. . . 0
12	2182.	2341.	* +	-159.	0 . .
13	3875.	3832.	+	43.6	. .0 .
14	3674.	3673.	+	1.56	. 0 .
15	4758.	4853.	*+	-84.7	. 0 . .
16	5671.	5749.	*+	-78.2	. 0 . .
17	5736.	5207.	+ *	530.	. . . 0

16 - (GNP) GROSS NATIONAL PRODUCT (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9962 (SQUARED = .9925)

ROOT-MEAN-SQUARED ERROR = 158.4

MEAN ABSOLUTE ERROR = 89.03

MEAN ERROR = 31.16

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.021

THEIL'S INEQUALITY COEFFICIENT = .3008D-01

FRACTION OF ERROR DUE TO BIAS = .3868D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .7121D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8901

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .5077D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9106

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT	RESIDUAL	PLOT (0.0)
2	240.7	245.8	+	-5.10	. 0. .
3	305.4	317.6	+	-11.2	. 0. .
4	435.7	447.9	+	-12.2	. 0. .
5	559.7	553.8	+	5.86	. 0 .
6	648.5	632.8	+	15.7	. 0 .
7	882.4	876.3	+	6.13	. 0 .
8	1053.	1143.	*+	-89.8	. 0 . .
9	1113.	1136.	+	-23.0	. 0. .
10	1416.	1295.	+*	121.	. . 0.
11	1524.	1286.	+ *	238.	. . . 0
12	1928.	2087.	* +	-159.	0 . .
13	3624.	3580.	+	43.6	. .0 .
14	3348.	3347.	+	1.56	. 0 .
15	4389.	4474.	*+	-84.7	. 0 . .
16	5297.	5376.	*+	-78.2	. 0 . .
17	5406.	4877.	+ *	530.	. . . 0

17 - (RY) REAL GROSS NATIONAL PRODUCT (THE REDUCED MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9957 (SQUARED = .9914)

ROOT-MEAN-SQUARED ERROR = 57.54

MEAN ABSOLUTE ERROR = 51.18

MEAN ERROR = -5.221

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9811

THEIL'S INEQUALITY COEFFICIENT = .2600D-01

FRACTION OF ERROR DUE TO BIAS = .5977D-02

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .2450D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9695

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4073D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9533

ID	ACTUAL	FITTED	PLOT OF ACTUAL(*) AND FITTED(+) VALUES	RESIDUAL	PLOT OF RESIDUALS(0) 0.0
2	231.2	239.1	+	-7.85	. 0. .
3	292.7	290.0	+	2.79	. 0 .
4	391.7	376.4	+*	15.3	. .0 .
5	442.8	434.3	+*	8.51	. .0 .
6	481.1	472.9	+*	8.23	. .0 .
7	655.6	666.2	*+	-10.6	. 0. .
8	708.3	772.5	*+	-54.2	0 . .
9	707.4	758.3	*+	-50.9	.0 . .
10	927.2	852.1	+*	75.1	. . 0
11	995.5	836.1	+ *	159.	. . . 0
12	1176.	1283.	* +	-107.	0 . . .
13	1909.	2019.	* +	-109.	0 . . .
14	1736.	1767.	*+	-31.8	. 0 . .
15	2166.	2235.	*+	-69.2	0 . .
16	2450.	2418.	+*	32.6	. . 0 .
17	2010.	1944.	+*	65.8	. . 0

APPENDIX C

STATIC SIMULATION (THE COMPLETE MODEL)

1 - (RM1) DEMAND FOR REAL BALANCES (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9865 (SQUARED = .9733)

ROOT-MEAN-SQUARED ERROR = 35.88

MEAN ABSOLUTE ERROR = 22.23

MEAN ERROR = 6.135

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.038

THEIL'S INEQUALITY COEFFICIENT = .5379D-01

FRACTION OF ERROR DUE TO BIAS = .2924D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .8597D-01

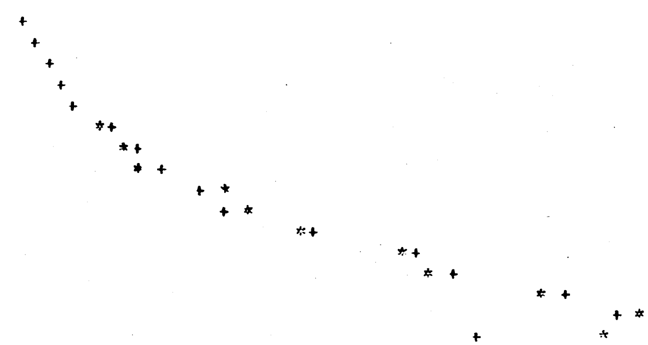
FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8848

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

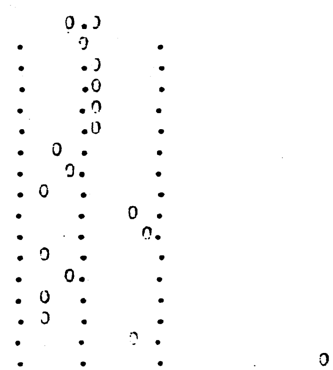
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4581D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9249

PLOT OF ACTUAL(*) AND FITTED(+) VALUES



PLOT OF RESIDUALS(O)



ID	ACTUAL	FITTED	RESIDUAL
2	32.39	34.30	-1.91
3	42.82	41.60	1.22
4	60.00	52.55	7.45
5	71.93	66.37	5.57
6	86.71	83.08	3.64
7	111.6	126.5	-14.9
8	135.8	144.1	-8.31
9	153.2	176.8	-23.6
10	238.7	215.6	23.1
11	269.8	235.7	34.1
12	313.4	336.8	-23.3
13	425.2	436.1	-10.8
14	449.8	472.7	-22.9
15	572.1	595.1	-23.0
16	667.9	640.4	27.4
17	627.4	5[illegible]3.[illegible]	124.

2 - (P) THE PRICE LEVEL (THE COMPLETE MODEL)

```
COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
**********************************************

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT =     .9965                          (SQUARED =    .9930    )

ROOT-MEAN-SQUARED ERROR =     .3617D-01

MEAN ABSOLUTE ERROR =     .3011D-01

MEAN ERROR =     .1262D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED =     1.012

THEIL'S INEQUALITY COEFFICIENT =     .1097D-01

FRACTION OF ERROR DUE TO BIAS =     .1216D-02

FRACTION OF ERROR DUE TO DIFFERENT VARIATION =     .3390D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION =     .9649

ALTERNATIVE DECOMPOSITION  (LAST 2 COMPONENTS):

     FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY =     .2040D-01

     FRACTION OF ERROR DUE TO RESIDUAL VARIANCE =     .9784

                          PLOT OF ACTUAL(*) AND FITTED(+) VALUES                    PLOT OF RESIDUALS(O)

ID   ACTUAL      FITTED                                                  RESIDUAL
                                                                                              0.0
 2   1.041       1.028    +                                               .134E-01       .       . O     .
 3   1.047       1.091     *+                                            -.440E-01      O.       .       .
 4   1.112       1.185     *   +                                         -.734E-01 O     .       .       .
 5   1.264       1.283           *+                                      -.191E-01       .   O   .       .
 6   1.348       1.338             +                                      .100E-01       .       . O     .
 7   1.346       1.317             +                                      .291E-01       .       .     O.
 8   1.487       1.475                 +*                                 .117E-01       .       . O     .
 9   1.574       1.499                  + *                               .750E-01       .       .       .         O
10   1.527       1.513                  +*                                .141E-01       .       . O     .
11   1.531       1.549                   +                               -.178E-01       .   O   .       .
12   1.640       1.618                     +*                             .224E-01       .       .  O    .
13   1.773       1.811                         *+                        -.379E-01       O       .       .
14   1.929       1.907                            +*                      .221E-01       .       .  O    .
15   2.027       1.984                             +*                     .428E-01       .       .       .O
16   2.162       2.201                                 *  +              -.386E-01       O       .       .
17   2.690       2.680                                            +       .104E-01       .       . O     .
```

3 - (Ph) THE PRICE LEVEL OF HOUSING (THE COMPLETE MODEL)

```
COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
**********************************************

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT =    .9530                        (SQUARED =    .9178    )

ROOT-MEAN-SQUARED ERROR =    .2705

MEAN ABSOLUTE ERROR =    .1367

MEAN ERROR =    .78110-01

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED =    1.201

THEIL'S INEQUALITY COEFFICIENT =    .66450-01

FRACTION OF ERROR DUE TO BIAS =    .83400-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION =    .3479

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION =    .5687

ALTERNATIVE DECOMPOSITION  (LAST 2 COMPONENTS):

     FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY =    .2186

     FRACTION OF ERROR DUE TO RESIDUAL VARIANCE =    .6980


                        PLOT OF ACTUAL(*) AND FITTED(+) VALUES                    PLOT OF RESIDUALS(0)

ID   ACTUAL     FITTED                                               RESIDUAL
                                                                            0.0
  2   1.011     1.017    +                                           -.571E-02 .   0    .
  3   1.075     1.082     +                                          -.677E-02 .   0    .
  4   1.135     1.226      *+                                        -.912E-01 . 0 .    .
  5   1.429     1.382          +*                                     .469E-01 .   .0   .
  6   1.744     1.505           +    *                                .239     .   .    0
  7   1.625     1.692              *+                                -.671E-01 .  0.    .
  8   1.866     1.922                  +                             -.564E-01 .  0.    .
  9   1.394     1.375          +                                      .186E-01 .   0    .
 10   1.480     1.558           *  +                                 -.776E-01 .  0.    .
 11   1.635     1.623              +                                  .122E-01 .   0    .
 12   2.145     2.053                    +  *                         .924E-01 .   . 0  .
 13   2.397     2.337                          +*                     .597E-01 .   .0   .
 14   2.724     2.817                                *  +            -.930E-01 . 0 .    .
 15   2.740     2.491                            +     *              .249     .   .    0
 16   2.629     2.699                                 *+             -.711E-01 .  0.    .
 17   4.107     3.107                                        +     *  1.00     .   .    .          0
```

4 - $\left(\frac{CC}{DD}\right)$ DEMAND FOR CURRENCY-DEMAND DEPOSIT RATIO (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .8414 (SQUARED = .7079)

ROOT-MEAN-SQUARED ERROR = .1284

MEAN ABSOLUTE ERROR = .9123D-01

MEAN ERROR = .1822D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9841

THEIL'S INEQUALITY COEFFICIENT = .7327D-01

FRACTION OF ERROR DUE TO BIAS = .2013D-03

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .7194D-01

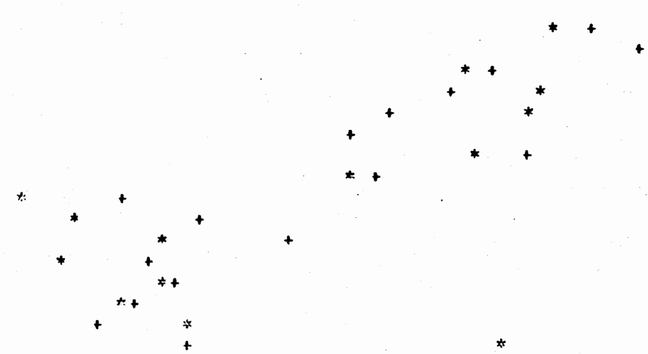
FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9279

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

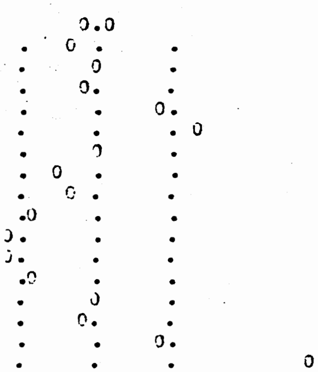
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .6340D-03

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9992

PLOT OF ACTUAL(*) AND FITTED(+) VALUES



PLOT OF RESIDUALS(0)



ID	ACTUAL	FITTED	RESIDUAL
2	1.118	1.160	-.421E-01
3	1.216	1.218	-.177E-02
4	1.014	1.042	-.276E-01
5	1.104	1.003	.101
6	1.091	.9180	.173
7	.8816	.8776	.397E-02
8	1.029	1.090	-.612E-01
9	.8714	.9116	-.402E-01
10	.4950	.6063	-.111
11	.5549	.7030	-.148
12	.6505	.8029	-.152
13	.5322	.6495	-.116
14	.7634	.7647	-.130E-02
15	.6198	.6328	-.130E-01
16	.6611	.5820	.991E-01
17	1.060	.6931	.367

5 - $(\frac{R}{DD})$ DEMAND FOR RESERVE-DEMAND DEPOSIT RATIO (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9545 (SQUARED = .911)

ROOT-MEAN-SQUARED ERROR = .2173D-01

MEAN ABSOLUTE ERROR = .1727D-01

MEAN ERROR = .2921D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.025

THEIL'S INEQUALITY COEFFICIENT = .3399D-01

FRACTION OF ERROR DUE TO BIAS = .1807D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .5130D-01

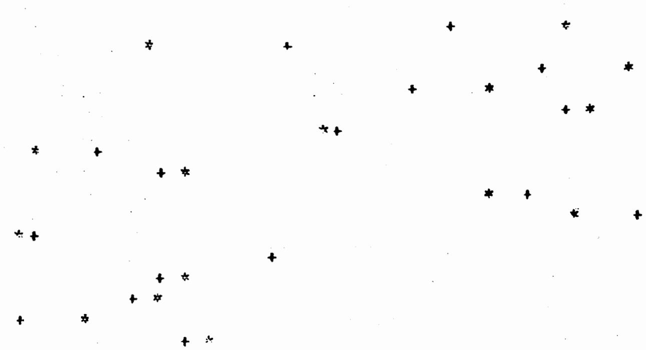
FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9306

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

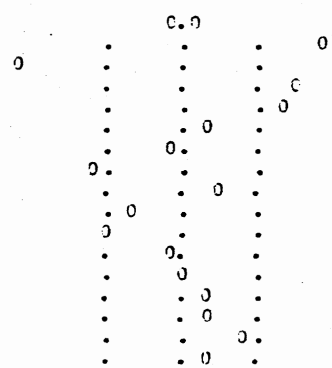
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .5731D-02

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9762

PLOT OF ACTUAL(*) AND FITTED(+) VALUES



PLOT OF RESIDUALS(O)



ID	ACTUAL	FITTED	RESIDUAL
2	.4020	.3622	.399E-01
3	.2570	.3036	-.466E-01
4	.4257	.3935	.322E-01
5	.3771	.3483	.288E-01
6	.4097	.4025	.725E-02
7	.3168	.3210	-.420E-02
8	.2181	.2417	-.236E-01
9	.2708	.2603	.105E-01
10	.3749	.3884	-.136E-01
11	.4070	.4281	-.211E-01
12	.2132	.2175	-.427E-02
13	.2997	.3012	-.149E-02
14	.2715	.2631	.842E-02
15	.2604	.2515	.887E-02
16	.2337	.2153	.184E-01
17	.2776	.2702	.732E-02

6 - (OY) PRODUCTION FUNCTION IN THE OIL SECTOR (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9934 (SQUARED = .9869)

ROOT-MEAN-SQUARED ERROR = 156.2

MEAN ABSOLUTE ERROR = 51.90

MEAN ERROR = -37.79

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9226

THEIL'S INEQUALITY COEFFICIENT = .4638D-01

FRACTION OF ERROR DUE TO BIAS = .5855D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .2771

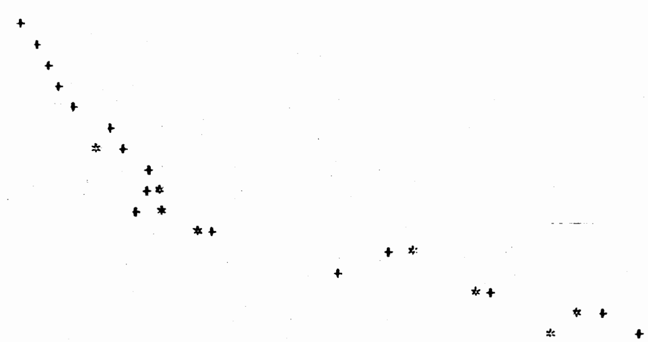
FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .6643

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

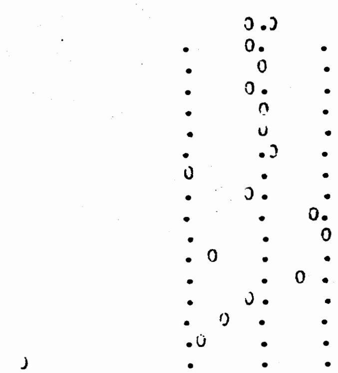
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .3265

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .6150

PLOT OF ACTUAL(*) AND FITTED(+) VALUES



PLOT OF RESIDUALS(0)



ID	ACTUAL	FITTED	RESIDUAL
2	99.60	101.8	-2.24
3	195.7	194.8	.851
4	270.1	282.5	-12.4
5	356.1	347.3	8.80
6	402.5	398.2	4.27
7	648.6	598.6	50.0
8	547.7	709.0	-161.
9	812.6	825.9	-13.3
10	922.1	807.0	115.
11	916.0	772.7	143.
12	1125.	1224.	-99.6
13	2375.	2264.	111.
14	1961.	1971.	-9.94
15	2750.	2835.	-85.2
16	3350.	3471.	-121.
17	3185.	3717.	-532.

7 - (RYP) PRODUCTION FUNCTION IN THE NON-OIL SECTOR (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9584 (SQUARED = .9186)

ROOT-MEAN-SQUARED ERROR = 93.65

MEAN ABSOLUTE ERROR = 44.29

MEAN ERROR = 22.66

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.019

THEIL'S INEQUALITY COEFFICIENT = .7801D-01

FRACTION OF ERROR DUE TO BIAS = .5857D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .4010D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9013

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .3502D-02

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9379

PLOT OF ACTUAL(*) AND FITTED(+) VALUES   PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	130.4	134.8	-4.41
3	161.3	165.2	-3.89
4	199.6	186.4	13.3
5	220.6	220.9	-.357
6	256.2	249.5	6.68
7	315.0	355.7	-40.7
8	454.1	408.0	46.1
9	302.2	323.9	-21.6
10	435.1	433.5	1.65
11	546.7	492.5	54.2
12	644.8	686.6	-41.8
13	846.3	883.9	-37.6
14	888.1	898.7	-10.6
15	995.6	1008.	-12.1
16	1074.	1025.	49.0
17	948.5	593.7	355.

8 - (RMKP) DEMAND FOR REAL IMPORTS OF CAPITAL GOODS (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9771 (SQUARED = .9547)

ROOT-MEAN-SQUARED ERROR = 21.63

MEAN ABSOLUTE ERROR = 12.47

MEAN ERROR = 4.859

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.038

THEIL'S INEQUALITY COEFFICIENT = .6994D-01

FRACTION OF ERROR DUE TO BIAS = .5349D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .6571D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8798

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2577D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9237

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	RESIDUAL
2	27.62	30.86	-3.24
3	33.38	33.63	-.256
4	39.84	34.52	5.31
5	53.01	49.01	4.00
6	43.09	46.51	-3.42
7	55.03	58.30	-3.27
8	57.32	57.60	-.279
9	38.86	40.20	-1.34
10	64.25	80.61	-16.4
11	109.7	93.08	16.6
12	176.3	181.3	-4.98
13	253.6	205.6	48.0
14	300.0	299.6	.364
15	242.6	256.7	-14.1
16	242.1	255.8	-13.7
17	256.6	192.2	64.4

9 - (RMC) DEMAND FOR REAL IMPORTS OF CONSUMER GOODS (THE COMPLETE MODEL)

```
COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
**********************************************

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT =    .9965                        (SQUARED =    .9929    )

ROOT-MEAN-SQUARED ERROR =    6.775

MEAN ABSOLUTE ERROR =    4.853

MEAN ERROR =    1.008

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED =    1.019

THEIL'S INEQUALITY COEFFICIENT =    .2401D-01

FRACTION OF ERROR DUE TO BIAS =    .2212D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION =    .6633D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION =    .9115

ALTERNATIVE DECOMPOSITION  (LAST 2 COMPONENTS):

     FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY =    .4707D-01

     FRACTION OF ERROR DUE TO RESIDUAL VARIANCE =    .9308

                  PLOT OF ACTUAL(*) AND FITTED(+) VALUES                          PLOT OF RESIDUALS(0)

ID    ACTUAL    FITTED                                                         RESIDUAL
                                                                                          0.0
 2    30.86     30.30   +                                                        .565    .     .0    .
 3    39.48     39.38     +                                                      .103    .     0     .
 4    43.46     46.59      *+                                                   -3.13    .  0  .     .
 5    50.29     48.19       +                                                    2.09    .     . 0   .
 6    59.61     57.41          +                                                 2.19    .     . 0   .
 7    74.70     73.21             +*                                             1.49    .     .0    .
 8    68.57     71.11            *+                                             -2.55    .  0  .     .
 9    66.67     69.71            *+                                             -3.04    .  0  .     .
10    86.98     84.61                +                                           2.37    .     . 0   .
11    102.6     97.47                   +*                                       5.09    .     .   0 .
12    144.1     155.6                              * +                          -11.5 0   .     .     .
13    198.9     195.5                                          +*                3.42    .     .  0  .
14    229.4     225.9                                                  +*        3.50    .     .  0  .
15    215.4     225.9                                                *  +       -10.5  0 .     .     .
16    253.5     245.9                                                      + *   7.62    .     .     0
17    236.0     217.6                                                *   *       18.4    .     .     .         0
```

10 - (RM) THE RATE OF INFLATION (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9105 (SQUARED = .8289)

ROOT-MEAN-SQUARED ERROR = .2776D-01

MEAN ABSOLUTE ERROR = .2180D-01

MEAN ERROR = -.1125D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .8363

THEIL'S INEQUALITY COEFFICIENT = .1486

FRACTION OF ERROR DUE TO BIAS = .1643D-02

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .3874D-01

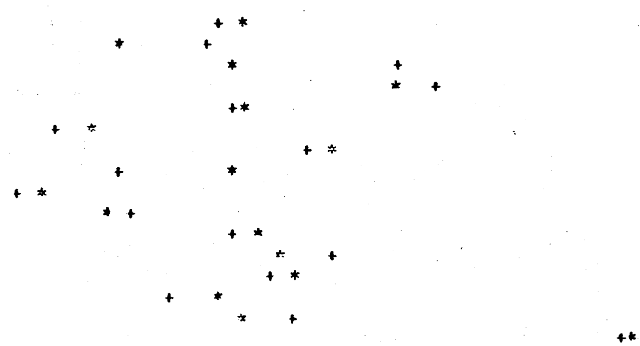
FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9596

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

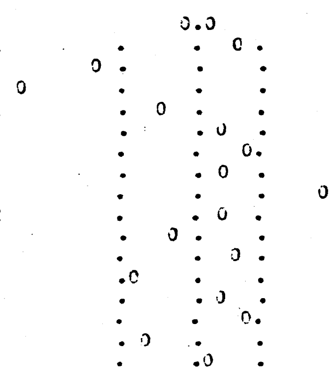
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .1564

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .8419

PLOT OF ACTUAL(*) AND FITTED(+) VALUES



PLOT OF RESIDUALS(0)



ID	ACTUAL	FITTED	RESIDUAL
2	.6660E-01	.5290E-01	.137E-01
3	.5764E-02	.4804E-01	-.423E-01
4	.6208E-01	.1322	-.701E-01
5	.1367	.1539	-.172E-01
6	.6646E-01	.5851E-01	.794E-02
7	-.1484E-02	-.2303E-01	.216E-01
8	.1048	.9605E-01	.870E-02
9	.5851E-01	.8101E-02	.504E-01
10	-.2586E-01	-.3482E-01	.896E-02
11	.2619E-02	.1424E-01	-.116E-01
12	.7120E-01	.5657E-01	.146E-01
13	.8110E-01	.1042	-.231E-01
14	.8799E-01	.7550E-01	.125E-01
15	.5080E-01	.2863E-01	.222E-01
16	.6660E-01	.8563E-01	-.190E-01
17	.2442	.2394	.482E-02

300

11 - (RS) THE RENTAL PRICE OF MONEY SUBSTITUTE (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .7885 (SQUARED = .6218)

ROOT-MEAN-SQUARED ERROR = .1125

MEAN ABSOLUTE ERROR = .6717D-01

MEAN ERROR = .3077D-01

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.098

THEIL'S INEQUALITY COEFFICIENT = .3172

FRACTION OF ERROR DUE TO BIAS = .7483D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .1914

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .7338

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .1185E-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9133

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	RESIDUAL
2	.6871E-01	.7474E-01	-.603E-02
3	.6330E-01	.7000E-01	-.670E-02
4	.5581E-01	.1407	-.849E-01
5	.2590	.2177	.413E-01
6	.2204	.5290E-01	.168
7	-.6823E-01	-.2977E-01	-.385E-01
8	.1483	.1830	-.347E-01
9	-.2529	-.2629	.996E-02
10	.6169E-01	.1174	-.557E-01
11	.1047	.9651E-01	.822E-02
12	.3119	.2554	.565E-01
13	.1175	.8963E-01	.279E-01
14	.1364	.1752	-.388E-01
15	.5874E-02	-.8567E-01	.915E-01
16	-.4088E-01	-.1494E-01	-.259E-01
17	.5728	.1922	* .381

12 - (MU1) THE MONEY MULTIPLIER (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9470 (SQUARED = .8969)

ROOT-MEAN-SQUARED ERROR = .3135D-01

MEAN ABSOLUTE ERROR = .2503D-01

MEAN ERROR = -.4462D-02

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .8296

THEIL'S INEQUALITY COEFFICIENT = .1277D-01

FRACTION OF ERROR DUE TO BIAS = .2026D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .1392

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .8405

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2630

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .7168

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	PLOT	RESIDUAL
2	1.257	1.281	* +	-.233E-01
3	1.262	1.229	+ *	.328E-01
4	1.156	1.175	* +	-.189E-01
5	1.162	1.192	* +	-.297E-01
6	1.090	1.104	* +	-.136E-01
7	1.151	1.148	+*	.259E-02
8	1.149	1.130	+ *	.196E-01
9	1.208	1.211	+	-.269E-02
10	1.159	1.135	+ *	.236E-01
11	1.123	1.096	+ *	.270E-01
12	1.279	1.245	+ *	.331E-01
13	1.277	1.251	+ *	.259E-01
14	1.288	1.296	*+	-.816E-02
15	1.373	1.379	*+	-.618E-02
16	1.373	1.429	* +	-.562E-01
17	1.245	1.322	* +	-.773E-01

0.0

13 - (MS1) MONEY SUPPLY (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9903 (SQUARED = .9807)

ROOT-MEAN-SQUARED ERROR = 104.8

MEAN ABSOLUTE ERROR = 42.67

MEAN ERROR = -27.86

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .8748

THEIL'S INEQUALITY COEFFICIENT = .6959D-01

FRACTION OF ERROR DUE TO BIAS = .7065D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .4109

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .5185

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4735

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .4558

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	PLOT OF ACTUAL(*) AND FITTED(+)	RESIDUAL	PLOT OF RESIDUALS(O) (0.0)
2	33.57	31.64	+	1.93	. O .
3	44.79	39.48	+	5.31	. O .
4	66.70	63.69	+	3.01	. O .
5	90.90	100.1	*+	-9.23	. O .
6	116.8	117.6	+	-.786	. O .
7	150.2	151.5	+	-1.33	. O .
8	201.7	195.2	+	6.43	. O .
9	241.1	243.3	+	-2.19	. O .
10	364.5	335.5	+*	29.0	. .O .
11	413.0	435.8	*+	-22.8	. O. .
12	514.0	476.5	+	37.5	. . O .
13	753.9	833.9	* +	-80.1	.O . .
14	867.5	897.8	*+	-30.3	. O. .
15	1139.	1104.	+*	35.3	. . O .
16	1444.	1456.	+	-12.6	. O. .
17	1698.	2103.	* +	-405.	O . . .

14 - (MX1) INDEX NUMBER OF MONEY SUPPLY (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9903 (SQUARED = .9806)

ROOT-MEAN-SQUARED ERROR = 2.339

MEAN ABSOLUTE ERROR = .9524

MEAN ERROR = -.6201

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .8748

THEIL'S INEQUALITY COEFFICIENT = .6959D-01

FRACTION OF ERROR DUE TO BIAS = .7029D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .4109

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .5188

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4736

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .4561

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	.7527	.7063	.464E-01
3	1.001	.8813	.119
4	1.489	1.422	.678E-01
5	2.030	2.235	-.205
6	2.609	2.625	-.153E-01
7	3.354	3.382	-.282E-01
8	4.507	4.358	.149
9	5.383	5.430	-.466E-01
10	8.137	7.488	.648
11	9.219	9.727	-.507
12	11.47	10.64	.839
13	16.83	18.61	-1.79
14	19.37	20.04	-.674
15	25.43	24.64	.790
16	32.23	32.51	-.278
17	37.67	46.71	-9.04

15 - (GDP) GROSS DOMESTIC PRODUCT (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9975 (SQUARED = .9950)

ROOT-MEAN-SQUARED ERROR = 135.3

MEAN ABSOLUTE ERROR = 77.71

MEAN ERROR = 24.90

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.015

THEIL'S INEQUALITY COEFFICIENT = .2368D-01

FRACTION OF ERROR DUE TO BIAS = .3389D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .5813D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9080

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4294D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9232

ID	ACTUAL	FITTED	PLOT OF ACTUAL (*) AND FITTED(+) VALUES	RESIDUAL	PLOT OF RESIDUALS(0)
					0.0
2	235.3	240.3	+	-5.03	. 0 .
3	364.6	375.1	+	-10.5	. 0 .
4	492.1	503.5	+	-11.4	. 0 .
5	634.9	630.8	+	4.12	. 0 .
6	747.8	732.0	+*	15.8	. .0 .
7	1073.	1067.	+	5.56	. .0 .
8	1223.	1311.	*+	-88.0	. 0 . .
9	1288.	1311.	*+	-23.1	. 0. .
10	1586.	1463.	+*	124.	. . 0.
11	1753.	1520.	+ *	233.	. . . 0
12	2182.	2335.	* +	-153.	0. . .
13	3875.	3865.	+	10.5	. .0 .
14	3674.	3685.	+	-10.5	. 0 .
15	4768.	4835.	*+	-66.6	. 0 . .
16	5671.	5726.	*+	-54.7	. 0 . .
17	5736.	5308.	+ *	428.	. . . 0

16 - (GNP) GROSS NATIONAL PRODUCT (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9972 (SQUARED = .9944)

ROOT-MEAN-SQUARED ERROR = 135.3

MEAN ABSOLUTE ERROR = 77.71

MEAN ERROR = 24.90

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.017

THEIL'S INEQUALITY COEFFICIENT = .2563D-01

FRACTION OF ERROR DUE TO BIAS = .3388D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .6070D-01

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9054

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .4430D-01

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9218

PLOT OF ACTUAL(*) AND FITTED(+) VALUES | PLOT OF RESIDUALS(O)

TO	ACTUAL	FITTED	RESIDUAL
2	240.7	245.7	-5.03
3	306.4	316.9	-10.5
4	435.7	447.1	-11.4
5	559.7	555.6	4.12
6	648.5	632.7	15.8
7	882.4	876.8	5.56
8	1053.	1141.	-88.0
9	1113.	1137.	-23.1
10	1416.	1292.	124.
11	1524.	1291.	233.
12	1928.	2081.	-153.
13	2624.	2613.	10.5
14	3248.	3359.	-10.5
15	4389.	4456.	-66.6
16	5297.	5352.	-54.7
17	5406.	4978.	428.

17 - (RY) REAL GROSS NATIONAL PRODUCT (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9946 (SQUARED = .9892)

ROOT-MEAN-SQUARED ERROR = 74.52

MEAN ABSOLUTE ERROR = 54.79

MEAN ERROR = .2044

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9876

THEIL'S INEQUALITY COEFFICIENT = .2881D-01

FRACTION OF ERROR DUE TO BIAS = .7501D-05

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .4581D-02

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .9954

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

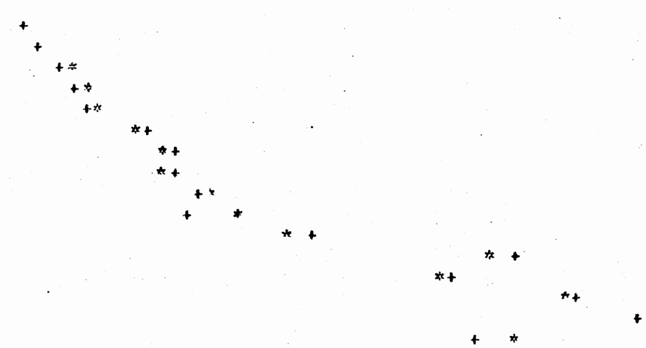
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .1427D-01

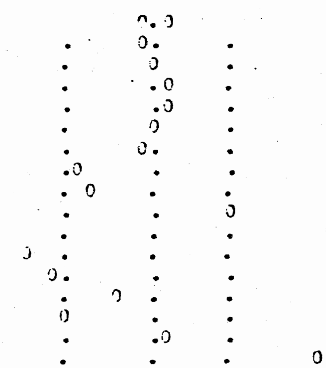
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .9857

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

PLOT OF RESIDUALS(0)

ID	ACTUAL	FITTED	RESIDUAL
2	231.2	239.1	-7.90
3	292.7	290.5	2.28
4	391.7	377.1	14.6
5	442.8	433.0	9.82
6	431.1	472.9	8.19
7	655.6	665.8	-10.2
8	708.3	773.5	-65.3
9	707.4	758.2	-50.8
10	927.2	854.1	73.1
11	935.5	8[illegible]3.7	162.
12	1176.	1286.	-111.
13	1909.	1995.	-85.9
14	1726.	1761.	-25.7
15	2166.	2246.	-80.2
16	2450.	2432.	18.1
17	2010.	1858.	152.





18 - (NM) NET IMPORTS (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9970 (SQUARED = .9940)

ROOT-MEAN-SQUARED ERROR = 61.91

MEAN ABSOLUTE ERROR = 29.56

MEAN ERROR = 15.51

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = 1.033

THEIL'S INEQUALITY COEFFICIENT = .3062D-01

FRACTION OF ERROR DUE TO BIAS = .6277D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .1651

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .7721

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .1383

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .7990

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	RESIDUAL
2	65.90	67.87	-1.97
3	79.90	83.27	-3.37
4	105.9	109.4	-3.53
5	160.6	154.8	5.84
6	175.2	175.8	-.610
7	230.9	229.5	1.42
8	269.0	271.7	-2.69
9	256.8	255.5	1.35
10	371.1	390.1	-19.0
11	552.4	522.6	29.8
12	788.4	807.9	-19.5
13	1327.	1251.	76.0
14	1595.	1576.	19.1
15	1549.	1578.	-29.3
16	2069.	2102.	-32.5
17	2119.	1892.	227.

19 - (NFA) NET FOREIGN ASSETS (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9952 (SQUARED = .9904)

ROOT-MEAN-SQUARED ERROR = 61.91

MEAN ABSOLUTE ERROR = 29.56

MEAN ERROR = -15.51

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9458

THEIL'S INEQUALITY COEFFICIENT = .3631D-01

FRACTION OF ERROR DUE TO BIAS = .6277D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .1985

FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .7387

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .2369

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .7004

PLOT OF ACTUAL(*) AND FITTED(+) VALUES PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	RESIDUAL
2	44.00	42.03	1.97
3	62.00	58.63	3.37
4	89.30	85.77	3.53
5	121.5	127.3	-5.84
6	136.0	135.4	.610
7	190.1	191.5	-1.42
8	326.5	323.8	2.69
9	573.7	575.0	-1.35
10	882.9	863.9	19.0
11	970.3	1001.	-29.8
12	654.8	635.3	19.5
13	1282.	1358.	-76.0
14	772.3	791.4	-19.1
15	1112.	1082.	29.3
16	1659.	1627.	32.5
17	1526.	1753.	-227.

20 - (H) MONETARY BASE (THE COMPLETE MODEL)

COMPARISON OF ACTUAL AND PREDICTED TIME SERIES
****

ACTUAL AND PREDICTED VARIABLES...

CORRELATION COEFFICIENT = .9930 (SQUARED = .9860)

ROOT-MEAN-SQUARED ERROR = 61.91

MEAN ABSOLUTE ERROR = 25.57

MEAN ERROR = -15.52

REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED = .9079

THEIL'S INEQUALITY COEFFICIENT = .5394D-01

FRACTION OF ERROR DUE TO BIAS = .6280D-01

FRACTION OF ERROR DUE TO DIFFERENT VARIATION = .3413

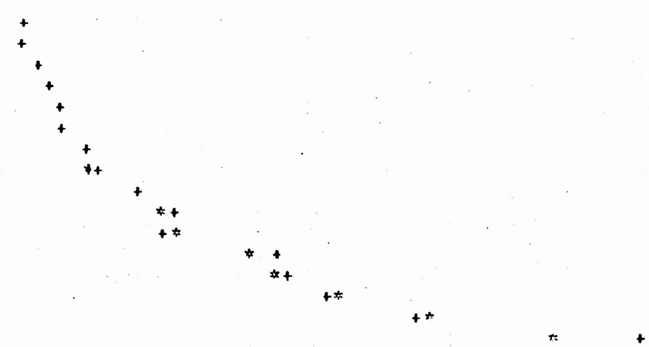
FRACTION OF ERROR DUE TO DIFFERENT CO-VARIATION = .5959

ALTERNATIVE DECOMPOSITION (LAST 2 COMPONENTS):

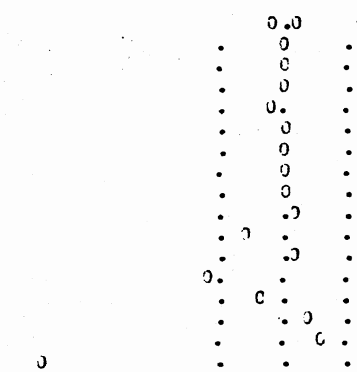
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY = .3942

FRACTION OF ERROR DUE TO RESIDUAL VARIANCE = .5430

PLOT OF ACTUAL(*) AND FITTED(+) VALUES



PLOT OF RESIDUALS(O)



ID	ACTUAL	FITTED	RESIDUAL
2	26.70	24.73	1.97
3	35.50	32.13	3.37
4	57.70	54.17	3.53
5	78.20	84.04	-5.84
6	107.1	106.5	.610
7	130.5	131.9	-1.42
8	175.5	172.8	2.69
9	199.5	200.8	-1.35
10	314.6	295.6	19.0
11	367.8	397.6	-29.8
12	402.0	382.5	19.5
13	590.2	666.3	-76.1
14	673.4	692.5	-19.1
15	829.7	800.4	29.3
16	1052.	1019.	32.5
17	1356.	1583.	-227.

VITA

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