

OCCASIONAL PAPER

Estimating the Demand for Money in Namibia

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Introduction

The study of the demand for money function is a central issue in monetary economics. This is because a stable demand for money function is essential for the conduct of effective monetary policy. Monetary policy seeks to influence money, credit and prices through the liquidity position of banks and other related financial institutions. Since the demand for money function helps to ascertain the liquidity needs of the economy, knowledge of the factors that determine this function and the existence of a stable long-run relationship between these factors and the money stock constitute legitimate enquiries by the monetary authorities. This role of the demand for money in the monetary process has generated quite a substantial body of empirical work in the academic literature.¹ To our knowledge no study has been undertaken for the Namibian economy in this area. Thus this study aims at estimating an empirically robust and theoretically consistent model of the demand for broad money in Namibia for the period 1990 to 1998 using quarterly observations.

Specifically, the objectives of this paper are threefold. The first is to estimate a demand for money function for Namibia using the current methodology of cointegration and error correction modelling. The second objective is to identify the relevant factors in the demand for money in Namibia. The theoretical literature on the demand for money has given rise to many questions, which have been the subject of substantial empirical testing. Some of these include, the relevant scale variable in the demand for money function whether income or wealth, the relevant opportunity costs of holding money whether long-term or short-term interest rates or whether domestic or foreign interest rates and the appropriate definition of money, whether narrow or broad money. These issues will receive our attention in this study. The third objective will be to test for the stability of the demand for money function given the importance of the stability issue for the conduct of monetary policy.

The paper is divided into seven sections. Section 1 is an introduction. In Section 2 we review the growth path of real money balances in the economy between 1990 and 1998. Section 3 contains a specification and estimation of a simple model of the demand for money. Section 4 discusses the main empirical results of the model. In Section 5 we focus on the results of the stability analysis while Section 6 reviews some of the policy implications of our results. Finally in Section 7 we summarise our main conclusions.

2. Behaviour of Monetary Aggregates between 1990-1998.

Real broad money, M2, grew by a quarterly average of about 3.06 percent between 1990 and 1998. Two distinct periods can be distinguished in this growth trend. After a brief spurt in the growth rate of real money balances between 1990 and 1991, the growth rate stabilised around an average of about 3.5 percent between 1991 and 1995. By 1996, there was a reversal in trend as M2 growth slowed to about 1.4 percent. This trend was maintained till the last quarter of 1998. The average quarterly growth in Real money, narrowly defined, M1 reported about 3.04 percent for the entire period. M1 reported a growth rate of 2.7 percent for the period 1990.1 to 1995.4 and rose rapidly to a growth rate of 3.9 percent for the 1996.1 to 1998.4 periods. The reported growth in real broad money for the 1990 to 1996 period was mainly accounted for by the growth of Quasi money which reported an

average of about 4.0 percent for that period. This is to be compared with the quarterly growth rate of 0.6 percent recorded for the period 1996.1 to 1998.4. The rapid increase in monetary aggregates in the early 1990's could be attributed to the widening and deepening of the financial system, which resulted from the opening up of vast areas of the country for productive and financial activities after independence.

It is also worthy of note that the behaviour of the broad aggregates of money supply tracked very well the movements in the consumer price index for the period. On average the growth of consumer prices reported a quarterly average of about 2.6 percent for the entire period. Between the first quarter of 1990 and the last quarter of 1991, consumer prices grew by about 3.0 percent and declined thereafter to about 2.2 percent till the last

Table 1. Selected Key Economic Indicators

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|-----------------------------|-------|------|------|------|-------|------|------|------|
| Real Narrow Money | -0.16 | 13.3 | 41.9 | 5.3 | -0.27 | 51.2 | -5.6 | 19.6 |
| Real Broad Money | 29.8 | 13.4 | 12.1 | 15.9 | 13.8 | 14.5 | 0.56 | 1.7 |
| Consumer Price Index | 12.4 | 13.3 | 8.5 | 11.8 | 8.4 | 8.37 | 7.2 | 8.65 |
| Real GDP | 10.3 | 6.3 | -2.0 | 6.7 | 3.4 | 2.9 | 1.8 | 1.9 |

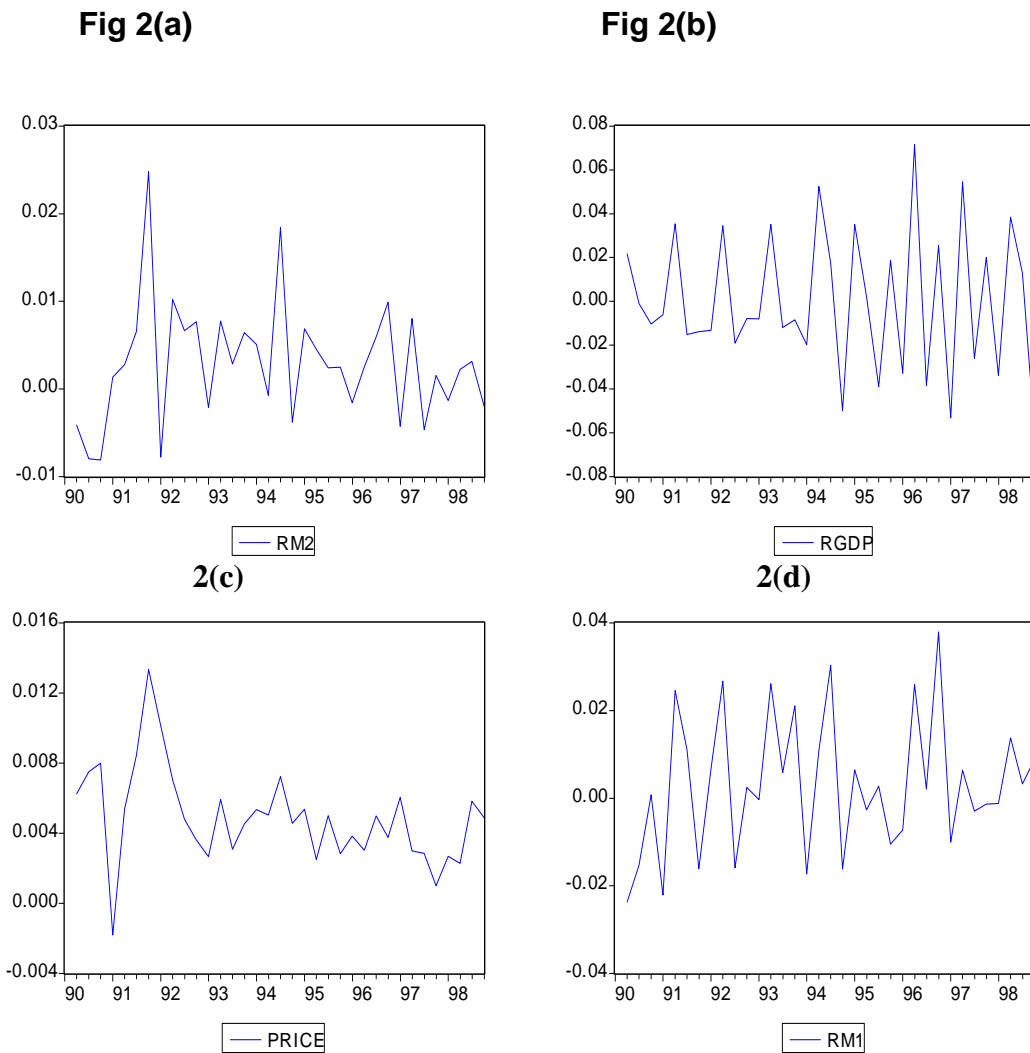
quarter in 1995. It took a further fall to about 1.6 percent in the first quarter of 1996, a trend that was maintained till the last quarter of 1998. Thus, though the opportunity cost of holding money (inflation) has declined considerably what has been observed is a movement away from broad money holding to narrow money (transactions balances) and an overall contraction in the broad measure of money supply in the past two years. A major factor in the deceleration of the consumer prices is the tight stance of monetary policy pursued by South Africa. Inflation in Namibia is a reflection of the South African rate given the pegged exchange rate arrangement between the Namibian dollar and the South African rand.²

The changes in real money balances can also be closely associated with changes in economic activities as represented by the GDP. Although for most periods the growth rate of real money balances far outpaces the growth in real GDP, the trend in both variables is remarkable particularly for the period 1990 to 1993 and lately between 1996 and 1998. Real GDP growth reported a quarterly average growth rate of 0.6 percent between 1990 and 1995 and thereafter fell to 0.5 percent. Thus the contraction in monetary aggregates between 1996 and 1998 coincided with a slowdown of economic activities.

¹ See Laidler (1993) for a survey of some of the literature on the demand for money.

² See Gaomab (1998) for a detailed analysis of the inflationary process in Namibia. The author actually provided evidence on the close correlation between money supply growth rates and inflation in Namibia.

Figure 2. Growth path of Real money



The velocity of money in Namibia has been steadily declining since independence reflecting largely the increasing monetisation of the economy. The steep decline in M1 velocity relative to that of quasi-money and broad money reflects the pronounced growth rates of M1 relative to income during the period under review. The faster decline in money velocity has partly offset the inflationary potential of the growth in money supply.

3. Model Specification and Estimation.

3.1 Model Specification

The demand for money function is normally stated as a function of the level of income (or some other scale variable) and the opportunity cost of money, which in turn is determined by the market rate of interest and the expected rate of price inflation.

Thus,

$$RM = a_0 + a_1 INFLR + a_2 RGDP + a_3 Ra + a_4 Ro \quad (1)$$

Where,

- RM is the real stock of money
- Ra is the rate of return on alternative assets
- Ro is the own rate of return on money
- RGDP is real income and
- INFLR is the expected inflation rate

Using the logarithmic form and redefining our variables equation (1) is written as

$$\text{LRM1} = a_0 + a_1 \text{INFLR} + a_2 \text{LRGDP} + a_3 \text{LSATBR} + a_4 \text{LRER} + a_5 \text{LDEPR} + a_6 \text{LTRBR} + a_7 \text{LBR} + U \quad (2)$$

Where,

- SATBR= South African Treasury bills rate
- RER= Real exchange rate (N\$/ZAR)
- DEPR= deposit rate on six months commercial bank deposits
- TRBR= Namibian Treasury bill rates
- LBR= Long-term bond rate, and other variables are as defined earlier.

The basic formulation in equation (1) assumes that money demand adjusts instantaneously to changes in prices, incomes and interest rates. This would be the case where adjustments of financial portfolios are costless. Individuals and corporations tend to strike a balance between the cost of deviating from desired holdings and the cost of adjusting the level of their actual money holdings. Simply put, money holders may sometimes adjust sluggishly to fluctuations in the determinants of money demand. Second, most theoretical models suggest that money demand depends on expected prices, incomes and interest rates that need not be related to the actual levels of these variables. These two changes would dictate that there should be a lagged response of actual money holdings to desired money stock. To cater for this, empirical models on money demand in the past employed the assumption of partial adjustment, in which a fixed proportion of the difference between desired and actual holdings diminishes each period. Thus demand for money functions of the form

$$\text{LRM} = a_0 + a_1 \Delta \text{INFLR} + a_2 \Delta \text{RGDP} + a_3 \Delta \text{LSATBR} + a_4 \Delta \text{LRER} + a_5 \Delta \text{LDEPR} + a_6 \Delta \text{LTRBR} + a_7 \Delta \text{LBR} + a_8 \Delta \text{LRM}_{t-1} \quad (3)$$

became very popular where $(\text{LRM})_{t-1}$ formed the core of the adjustment mechanism. The introduction of the first difference specification followed from the need to avoid the problem of "spurious regression" resulting from the non-stationary of economic variables, an issue to which we shall shortly return. In recent times, this simplistic approach to the determination of the lag structure in economic models has been criticised as being overly restrictive and abstracts from reality (Hendry, 1979). The tendency to impose lag structures on economic models from the standpoint of economic theory (theory based dynamic specifications) may generate only models with very simple lag structures that may not match the actual data generation process and led to erroneous results (Yoshida, 1990; Adam, 1992). To overcome this shortcoming, an error-correction dynamic specification is employed. The error-correction money demand function can be written in the form

$$\begin{aligned} \Delta \text{LRM} = & \sum b_1 \Delta \text{LRM}_{t-i} + b_2 \Delta \text{INFLR}_{t-i} + b_3 \Delta \text{LRGDP}_{t-i} + b_4 \Delta \text{LSATBR}_{t-i} + \\ & b_5 \Delta \text{LRER}_{t-i} + b_6 \Delta \text{LDEPR}_{t-i} + b_7 \Delta \text{LTRBR}_{t-i} + b_8 \Delta \text{LBR}_{t-i} \\ & b_9 \Delta (\text{LRM} - \text{LRM}_{t-i}) + b_0 \end{aligned} \quad (4)$$

where the subscripts attached to the variables represent lagged values from equation 3. The distributed lags of first-difference terms are a mathematical representation of a general unrestricted, short-run relationship between the variables. The term with the co-efficient b_9 represents deviations from long-run equilibrium and gives the equation its error correcting properties. The static long-run equilibrium properties of the money demand function represented by equation (4) are identical to equation (1).³

3.2 Model Estimation

Recent studies have drawn attention to the fact that most time series data might exhibit non-stationary which is likely to result in ‘spurious regressions’ and the concomitant incorrect statistical inferences. Though first differencing can be used to overcome this problem, potentially useful information about long-run equilibrium relationships between economic variables might be lost. Level information may be of significance particularly when a group of variables is cointegrated. The existence of cointegrating relationships as is often found between money, income and prices may turn out to be significant for the existence of a long-run equilibrium relationship between the variables. If this occurs, it can be exploited for the estimation of an error-correction model (ECM). Such a cointegrating regression can produce relatively precise estimates even from a small sample with ‘super consistency’ characteristics (Engle and Granger, 1987). This is significant for a country like Namibia where time series data of considerable duration is not available. More importantly, the residuals formed by subtracting actual money balances from fitted values of the long-run relationship as in equation (1) would be stationary and would form a legitimate error-correction term to include in equation (5).

In this study we have adopted the method used by Engle and Granger (1987) in estimating our model. First, there is a preliminary analysis of the data to determine the order of integration of our variables. Second, a two-stage technique is followed. The first stage involves using variables that are co-integrated to estimate long run money demand model using OLS method. We test the residuals of this regression for stationary to determine whether the regression equation might represent a co-integrating relationship between money, prices and income. The fact that variables are cointegrated implies that there is some adjustment process, which prevents the errors in the long run relationships becoming larger and larger. Engle and Granger (1987) have shown that any cointegrated series have an error correction representation. The converse is also true, in that cointegration is a necessary condition for error-correction models to hold.⁴ In the second stage, an over-parameterised error correction model (equation 5) is estimated for the monetary aggregates. Equation (5) is specified first as a general distributed lag of first differences in the dependent and independent variables plus the lagged residuals from equation (1)- the error correction term.

³ For a detailed discussion of this approach see Tseng and Corker (1991), Yoshida (1990)

⁴ See for instance Engle and Granger 1991 pp.7-8

As explained in footnote 3 the maximum lag permissible in this work is 3.⁵ This general specification is then reduced to a more parsimonious and more interpretable form using some statistical and economic guidelines.

3.3 Statistical Properties of the Data.

Generally, the study of money demand in many developing countries is often constrained by serious data limitations, including the absence of a continuous time series observation on key monetary and real variables and the lack of high frequency (e.g. monthly and quarterly) indicators of economic activity. This has constrained us to restricting our study to the period between 1990 and 1998, a period that has coincided with the establishment of the Bank of Namibia as a fully fledged central bank and the improvement in data gathering process.

Sources of Data

The main sources of data used include the Bank of Namibia Annual Report and Quarterly Bulletin. This was supplemented by data from the Bureau of Statistics and the International Financial Statistics (IFS) of the IMF and South African Reserve Bank Annual and Quarterly reports.

Specifically,

- M2 is the stock of broad money, obtained directly from the BON publications.
- CPI the consumer price index was obtained from the IFS but since the Bureau of statistics only started to compile CPI series for Namibia in 1990 the CPI series for the for the period 1990:1 to 1990:4 was proxied by RSA CPI series and was obtained from the SARB's annual reports. This variable is used for deflating the monetary aggregate and for measuring the rate of inflation. This is about the most reliable price index published for the moment in the economy.
- GDP is the indicator for transactions demand for money. It is our major indicator of economic activity. We are aware of the shortcomings in the use of this variable as a measure of wealth but the non-availability of data for other measures of wealth precluded their use in this study.⁶
- Four alternative interest rate measures are used in this study. The first is the deposit rate on six months deposits at the commercial banks. This is considered a representative rate of interest on savings and time deposits.⁷ The second rate of interest tried in our model is the long-term bond rate and is proxied by South African bond rate. This has been tried in a number of studies.⁸ It has been argued that the relevant opportunity cost in holding money may not necessarily be some short-term rate of interest particularly in countries witnessing low inflation. The third rate of interest is a short-term treasury bills rate. Both the Namibian series and the South African series are experimented with in this study. The reason for trying the latter is to ascertain the relevance of the return on foreign opportunity costs in this case the South African Treasury bill rate to the demand for money in Namibia. For a long time it has been asserted that due to the close financial integration between Namibia and RSA, money market conditions in the former simply respond to South African conditions thus precluding any attempts to influence interest rates domestically.

⁵ Due to limited number of observations in our series, the maximum number of lags that could be accommodated was 3.

⁶ Quarterly series on GDP are presently not available in the Bank for the whole period covered by the estimation. We obtained our quarterly series by using a simple linear interpolation technique using mineral exports for the derivation of our GDP quarterly series. This method involved first extrapolating mineral exports back to 1990 since the series on mineral exports only cover the period 1993 to 1998. The details of this approach are included in a forthcoming paper – Ikhide (1999); *Exports and Economic Growth in Namibia*.

⁷ In Namibia demand deposits also earn a rate of return so that the deposit rate is computed as a weighted average of the returns on demand, time and savings deposit.

- The expected real exchange rate of the Namibian dollar was computed against the South African rand since this is the currency of our major trading partner. The literature on the demand for money in developing countries has also included enquiries on potential currency substitution effects. The rate of return to holding foreign currency may therefore be a determinant of money demand. This may be very important in Namibia where the South African rand and the Namibian dollar are still allowed to circulate side by side.
- Expected inflation is measured as the seasonal difference of the logarithm of the consumer price index-CPI. Expectations are assumed formed rationally.

The expected relationship between our dependent variables and the rate of interest is determined by the definition of money used. Three definitions of money are employed in this study. First is narrow money (M1) defined as currency and demand deposit. This narrow definition of money is tested for two reasons. It is the most common definition of the demand for money. Second, although assets shade almost imperceptibly away from each other in their liquidity, there seems to be a sharper liquidity at this point than any other. All assets other than demand deposits and currency have to be converted into either demand deposits or currency before they can be spent and in this sense only demand deposits and currency are truly the medium of exchange and thus satisfy our definition of money demand for transactions purposes. The demand for quasi-money is tested mainly to show the impact of interest rates on some alternatives of money narrowly defined. We also tested for the broad definition of money (M2) to throw some light on the controversy on which aggregate of money is a better definition in a developing economy. The speculative motive for holding money has received less emphasis in the literature on LDC's because of the perverse role of the rate of interest in those economies. Given the paucity of alternative financial assets, it is argued that transactions rather than speculative motives should hold sway. This we believe is an empirical issue.

The value of each parameter is contingent on the definition of the dependent variable. The transactions demand for money is reflected in positive income elasticity but tends to be larger for narrow than broad money. Two own rates of return are experimented with for broad money. First is the rate of return on six-months deposit that is fairly weighted in the Namibian economy towards savings and time deposits and a representative deposit rate, derived by multiplying the deposit rate by the share of quasi-money in broad money. This later is predicted on the assumption that currency, a component of narrow money is non-interest bearing.

The deposit rate is viewed as the opportunity cost of holding money and theoretical expectations dictate that this be negatively related to M1 while it is positively related to quasi-money holdings. The expected rate of inflation is expected to exercise a negative influence on all forms of money holdings regardless of the definition of money used. In effect inflation affects the allocation of wealth between money and real assets as well as other inflation hedges such as foreign and domestic financial assets.

4 Empirical Results

4.1 Unit Root Tests

The graphical representations of all the variables in equation 3 prior to the test for stationarity and first differencing are reproduced in appendix 1. The results of the Augmented Dickey-Fuller (ADF) test on all the series in this study is shown in Table 2. The tests were carried out in levels and first differences and were performed by including both

⁸ See for example Koenig (1994), pp.81-101

a constant and a deterministic trend in the regressions. The ADF tests did not reject the hypothesis of non-stationarity for the variables except GDP, and LRER. After first differencing, the ADF test rejects the hypothesis of non-stationarity, except for LTRBR.

Table 2. Unit Roots Test

| Variables | Augmented Dickey Fuller (ADF) | |
|-----------|-------------------------------|------------------|
| | Levels | First Difference |
| LRM2 | -1.55614 | -3.863558 |
| LRGDP | -5.2638 ** | -6.626840 |
| INFLR | -3.4451 | -4.170695 |
| LDEPR | -1.9949 | -3.612731 |
| LRER | -3.8677 ** | -3.916613 |
| LTRBR | -1.17815 | -3.238522 ** |
| LSATBR | -1.4779 | -5.535744 |
| LTR | -3.0429 | -4.865326 |

Notes: The Augmented Dickey Fuller (ADF) test was utilised to test for the presence of unit roots. The test was performed in levels and in first difference including both a constant and a deterministic trend. In levels the critical value for the ADF at 5% is -3.5468 and in difference the critical values for the ADF at 5% confidence level is -3.5514.

** means that the null hypothesis for the presence of unit roots is rejected at 5 percent confidence level.

4.2. Co-integration Results

The next step involved testing for the existence of a possible co-integrating relationship between real money balances and the explanatory variables.⁹ The bivariate and multivariate co-integrating relationship of the variables in the models produced residuals that are stationary confirming the existence of a long-run relationship (Tables 3-5).¹⁰ In Table 3, we show the bivariate and multivariate co-integrating regressions for log of real M1 as our regressor. Equation 7 where log of real narrow money (M1) is regressed on income, price and interest rates is used to form our error correction term for M1.

⁹ We note the problem that is likely to be created in using seasonal (quarterly) data to estimate the long-run models. This may give rise to inconsistent estimates (Engle and Granger) and Hallman (1998). Accordingly we deseasonalised all, our variables except inflation by first seasonally adjusting them before running the cointegration equations. The procedure for obtaining the rate of inflation from the CPI automatically extracts the seasonal roots.

¹⁰ According to Johansen (1988), there may be as many as $n-1$ linear combinations of n data series that are cointegrated. Theoretical considerations, as well as statistical criteria are used to choose among the possible long-run relationships.

Table 3. Bivariate and multivariate co-integration Regression for log of LRM1

| Equation | Constant | LRGDP | Inflr | Ldepr | Lrer | Lsatbr | R ² | ADF | Obs | F-Value |
|----------|---------------------|------------------|--------------------|---------------------|------|--------------------|----------------|-----------|-----|---------|
| 1. | -2.026 (-1.92) | 1.480 (3.98) | | | | | 0.58 | -4.259 ** | 33 | 13.74 |
| 2. | 1.4845 (1.784) | | | | | 0.252 (0.826) | 0.38 | -3.961 ** | 33 | 5.99 |
| 3. | 2.765 (3.003) | | | -0.231 (-0.647) | | | 0.34 | -3.994 ** | | 6.29 |
| 4. | -2.132 (-1.803) | 1.464 (3.808) | | | | 0.0554 (0.1210) | 0.57 | -4.157 ** | | 13.10 |
| 5. | -1.6110 (-1.465) | 1.379 (3.364) | -5.230 (-1.347) | | | | 0.55 | 3.751 ** | | 11.67 |
| 6. | -1.732 (-1.239) | 1.466 (3.867) | | -0.099 (-0.1327) | | | 0.59 | -4.392 * | | 14.21 |
| 7. | 1.459 (-1.005) | 1.373 (3.550) | -5.189 (-1.313) | -0.0533 (-0.163) | | | 0.56 | -3.848 ** | | 11.96 |

* 1% level of Significance (ADF critical value = -4.2712)

** 5% level of Significance (ADF critical value = -3.5562)

Figures in parenthesis are t-statistic

Table 4 reports the regressions for the log of real money balances broadly defined. Again here equation 6 where real M2 is regressed on prices, interest rates and real incomes is used to generate the error correction term.

The other bivariate regressions are shown in Table 5. The significance of our error-correction terms in all the equations attest to the fact that the variables in Table 3-5 are indeed co-integrated and also demonstrate their appropriateness as representations of the data. The results also confirm the existence of a stable long-run equilibrium relationship between money, income and prices in the economy. The income elasticity of the demand for money in the regressions is respectable and conforms to empirical antecedents for developing countries. For M1, the income elasticity range between 1.3 and 1.4. The estimated long-run income elasticity for broad money is lower ranging between 0.4 and 0.6. While the long-run income elasticity for narrow money accords very well with the quantity theory of money as in Fisher et al, the not so impressive results for M2 is in agreement with the Baumol-Tobin framework. The interest rate elasticity range between -0.05 and -0.09 for M1, and -0.2 to -0.5 for M2. These results are generally acceptable on the grounds that M1 is closely associated with money holding to undertake transactions while quasi-money which forms a substantial proportion of M2 is more closely related to speculative money holdings and hence more subject to portfolio shifts.¹¹

¹¹ Broadly similar results have been reported for Mozambique by Pinon-Farah (1998) and Ashfaque and Syed (1998) for Pakistan.

Table 4. Bivariate and multivariate co-integration Regression for the log of RM2

| Equation | Constant | LRGDP | Inflr | Ldepr | Lrer | Lsatbr | LB | R ² | ADF | Obs | F-Value |
|----------|------------------|-------------------|--------------------|------------------|---------------------|--------------------|------------------|----------------|-----------|-----|---------|
| 1. | 3.043 (98.6) | | | | -14.263 (-9.811) | | | 0.30 | -3.523*** | 33 | 4.15 |
| 2. | 4.487 (5.202) | | | 0.512 (-1.52) | | | | 0.38 | -3.978** | 33 | 6.16 |
| 3. | 3.863 (3.754) | | | | | -0.251 (-0.674) | | 0.32 | -3.591*** | 33 | 4.67 |
| 4. | 2.703 (3.879) | 0.4195 (2.091) | -2.503 (-1.337) | | -0.574 (-3.130) | | 0.254 (1.685) | 0.35 | -3.882** | 33 | 5.1 |

** 5% level of Significance (ADF critical value = -4.2712)

*** 10% level of Significance (ADF critical value = -3.5562)

Figures in parenthesis are t-statistics

Table 5. Bivariate and multivariate co-integration Regression for the log of RM2

| <u>Variables</u> | <u>R²</u> | <u>ADF</u> | <u>No. of Obs</u> | <u>F- Statistics</u> |
|----------------------|----------------------|------------|-------------------|----------------------|
| 1. LDEPR or LSATBR | 0.71 | -6.165 * | 36 | 24.5 |
| 2. LRER or LDEPR | 0.34 | -3.616 ** | 36 | 5.17 |
| 3. INFLATION or LRER | 0.38 | -3.530 *** | 32 | 5.87 |
| 4. LRGDP or LSATBR | 0.64 | -3.462 | 33 | 17.5 |
| 5. LSATBR or LTRBR | 0.93 | -13.214 | 33 | 146.7 |

*** 10 % level of significance (ADF critical value = -3.4773)

** 5 % level of significance (ADF critical value = -3.5731)

The estimated elasticities of demand for money narrowly defined may be a reflection of an economy undergoing transition. With monetisation, the demand for money to undertake transactions seemed to have risen faster than income growth. The coefficient for the rate of inflation came out significant and is appropriately signed.

4.3 Estimation

The results of our error-correction model are reported for M1, M2 and QM in Tables 6-9. Initially an over-parameterised ADL model was estimated for each monetary aggregate and through a process of model simplification, a parsimonious or preferred version is reported.¹²

Table 6: ECM Regression Results on $\Delta LRM2$

| Variable | Coefficient | Standard Error | T-Value |
|--------------------------|-------------|----------------|----------|
| $\Delta LRGDP_{sa}$ | 0.202725 | 0.035966 | 5.636524 |
| $\Delta LRGDP_{sa} (-1)$ | 0.200555 | 0.052086 | 3.85049 |
| $\Delta LRGDP (-2)$ | 0.128588 | 0.039419 | 3.262101 |
| $\Delta LDEPR_{sa} (-1)$ | 0.172643 | 0.0605 | 2.855168 |
| $\Delta LRER_{sa} (-1)$ | 1.307 | 0.5336 | 2.4495 |
| $\Delta INFLR$ | 0.6942 | 0.3438 | 2.019077 |
| $\Delta LRM1_{sa}$ | -0.157 | 0.139 | -1.128 |
| $\Delta LSATBR_{sa}$ | -0.1538 | 0.0544 | -2.8279 |
| ECM(-1) | -0.6043 | 0.10873 | -5.559 |
| C | 0.000450 | 0.009243 | 0.9616 |

R^2 = 0.66
 D.W. = 2.1
 SC = -6.5
 F- Statistics = 5.42
 RSS = 0.016

Real money balances both narrowly and broadly defined are shown to respond positively to both the levels of income and their lagged values. While it is significant only at the first lag in QM, it is significant at the levels, first and second lag for M1 and the second and third lag for broad money. Real income is significant at 1% level for level first and second lags for M1 and at 5% level for M2. This again confirms the transactions properties of M1. The deposit rate came out with the expected (negative) sign in M1 and is significant at the 1-% level.

This indicates that an increase in the deposit rate will serve as an incentive for people to move into broad money holdings. We also tested the rate of return on M2 computed as discussed in section 3(LQ MM R) to make allowance for the quasi-money component of M2 (Table 8). Our results came out strong as this variable did not only come out with the expected sign but is also significant at both the first and second lag in the QM equation although it is wrongly signed at the third lag.

¹² Some insignificant variables have been reported where it is felt that such variables contribute significantly to the overall fit of the model or have significant economic implications.

Table 7: ECM Regression Results on $\Delta LRM2$

| Variable | Coefficient | Standard Error | T-Value |
|---------------------------|-------------|----------------|---------|
| $\Delta LRGDP_{sa}$ | 0.122 | 0.040 | 3.010 |
| $\Delta LRGDP_{sa} (-2)$ | 0.104 | 0.048 | 2.168 |
| $\Delta LRGDP_{sa} (-3)$ | 0.073 | 0.043 | 1.712 |
| $\Delta LRER_{sa} (-1)$ | 2.256 | 1.206 | 1.871 |
| $\Delta LRER_{sa} (-2)$ | 1.664 | 0.653 | 2.546 |
| $\Delta LRER_{sa} (-3)$ | 2.280 | 0.863 | 2.641 |
| $\Delta DEPR_{sa} (-2)$ | 0.336 | 0.089 | 3.767 |
| $\Delta LSATBR_{sa}$ | -0.227 | 0.072 | -3.117 |
| $\Delta LSATBR_{sa} (-2)$ | -0.177 | 0.063 | -2.820 |
| $\Delta LSATBR_{sa} (-3)$ | -0.0795 | 0.038 | -2.118 |
| $\Delta INFLR$ | 2.103 | 0.628 | 3.351 |
| $\Delta INFLR (-1)$ | 1.396 | 0.839 | 1.664 |
| $\Delta LRM2_{sa} (-1)$ | -0.415 | 0.121 | -3.424 |
| ECM(-1) | -0.3196 | 0.061 | -5.273 |
| $\Delta SER2$ | -0.026 | 0.015 | -1.807 |
| C | -0.020 | 0.014 | -1.456 |

R^2 = 0.89
 D.W. = 2.01
 SC = -6.67
 F- Statistics = 8.60
 RSS = 0.007

Table 8: ECM Regression Results on $\Delta LRM2$

| Variable | Coefficient | Standard Error | T-Statistics |
|--------------------------|-------------|----------------|--------------|
| $\Delta LRGDP_{sa}$ | 0.083 | 0.037 | 2.209 |
| $\Delta LRGDP_{sa} (-2)$ | 0.093 | 0.044 | 2.106 |
| $\Delta LRER_{sa} (-3)$ | 2.456 | 0.859 | 2.856 |
| $\Delta LQMM2R_{sa}$ | 0.121 | 0.039 | 3.042 |
| $\Delta LSATBR_{sa}$ | -0.1611 | 0.057 | -2.783 |
| $\Delta LRM2_{sa} (-1)$ | -0.295 | 0.145 | -2.038 |
| ECM(-1) | -0.295 | 0.145 | -2.318 |
| C | 0.043 | 0.007 | 5.978 |

R^2 = 0.61
 D.W. = 1.9
 SC = -6.37
 F- Statistics = 5.39
 RSS = 0.025

The expected yield on foreign assets represented by the yield on South African treasury bills was also statistically significant at the level (5% and 10% respectively for M1 and M2) and is rightly signed for broad money. This will tend to suggest that a rise in the Treasury bill rate in South Africa will lead to a fall in the demand for money (M1 and M2) in Namibia. This is indicative of the fact that economic agents in Namibia are very responsive to the movements in the money market rates in South Africa. The real exchange rate is positively signed and significant for both M1 and M2. This is not surprising given the strong relationship between the Namibian dollar and the South African rand. Our results suggest that a rise in the real exchange rate (a devaluation of the Namibian dollar) will engender a degree of substitution from the dollar to the rand. This is because economic agents will tend to view the latter as a hedge against further devaluation even though the Namibia dollar exchange rate is at par with the rand. This confirms the existence of some degree of currency substitution among economic agents.

The inflation variable came out with some surprising results in the monetary aggregates under investigation. Although this variable is significant at 1% and 5% at the level and first lag for M2, it is positively signed. For M1, it came out significant at the 5% level, but again it is positively signed. Since this is not theoretically plausible and in the absence of any empirical reasons for this behaviour, the only explanation could have been the inclusion of exchange rates and both deposit rates and the Treasury bill rate in the same equations. This is confirmed by the fact that when inflation is used alone with real incomes as explanatory variables, it comes out significant and is negatively signed in all aggregates of money. Our dummy variable Dser2 turned out significant for broad money at the 5% level. This will tend to capture the introduction of the Namibian currency in the last quarter of 1993.

The presence of significant error-correction term indicates a strong feedback effect of deviation of money demand from its long-run growth path. The coefficient on ECM (-1) for M1 shows a speed of adjustment of about 60.4 percent per quarter of the difference between actual and long-term equilibrium real money balances (Table 6). For M2, an adjustment of 61.4 % is recorded (Table 7) and for QM an adjustment of 85.2% is implied (Table 9). For all money aggregates, this means that market forces are in operation to restore long-run equilibrium following a short-run disturbance. On the average this will tend to suggest that after an initial disturbance it takes roughly 8 weeks for equilibrium to be restored. The t-statistics in each case show that the error-correction terms are significant at the 1-% level for M1 and M2 and at the 5% level for QM.

Table 9: ECM Regression Results on ΔLNRMsa

| Variable | Coefficient | Standard Error | T-Statistics |
|-------------------------------|-------------|----------------|--------------|
| $\Delta \text{LDEPRsa} (-2)$ | 0.739 | 0.192 | 3.853 |
| $\Delta \text{LRGDPsa}$ | 0.224 | 0.057 | 3.905 |
| ΔLRERsa | -8.825 | 1.620 | -5.447 |
| $\Delta \text{LRERsa} (-3)$ | 4.184 | 1.119 | 3.738 |
| $\Delta \text{LSATBRsa} (-3)$ | -0.064 | 0.0513 | -1.2395 |
| $\Delta \text{INFLRsa} (-2)$ | -2.823 | 1.058 | -2.669 |
| ΔSER2 | 0.065 | 0.024 | 2.752 |
| $\Delta \text{LNRMsa} (-1)$ | -0.130 | 0.119 | -1.091 |
| $\Delta \text{ECM}(-1)$ | -0.852 | 0.134 | -6.3699 |
| C | 0.080 | 0.023 | 3.496 |

R^2 = 0.79
D.W. = 2.32

| | | |
|---------------|---|--------|
| SC | = | -5.320 |
| F- Statistics | = | 9.34 |
| RSS | = | 0.0529 |

The other diagnostic tests carried out for M1 and M2 confirm that the model track the data well over the sample period - appendix 2. The R^2 is high for M1 and M2. For M1 an R^2 of 0.80 is reported while for M2 it is 0.88, indicating that for both monetary aggregates the explanatory variables explain over 80 % of changes in the demand for money. The results of the other diagnostic tests are shown in Table 10. These results further confirm that the model is consistent with the data. There is no evidence of higher or first order auto-correlation in the equation errors. The other statistics support the view that the distribution of the error term is independently and homoscedastically normal.¹³ The evidence from within our sample forecast accuracy further supports this hypothesis. Overall, we can conclude that the model adequately captures the salient features of the data and more importantly it is consistent with the main implications of economic theory.

5. Stability of money Demand.

We alluded to the fact that the stability of the demand for money is a crucial determinant of the effectiveness of monetary policy in our introduction. In addition to the positive results obtained for the cointegrating relationships between money income and prices for all the monetary aggregates, which in itself is an indication of stable long-run relationships between these variables, two types of tests are employed in this analysis to establish model stability. The need for this is suggested by the fact that while long-run relationships may be confirmed by the results of the co-integrating equations, it is possible that changes in the financial environment may have rendered unpredictable short-run deviations of money demand from their long-run equilibrium. Such deviations are observable from the instability of the coefficients of the determinants of money demand in equation 4. In order to find out if the coefficients of the full-error correction model are stable over the sample period, we performed the Cusum and Cusumsq tests.

For these tests the existence of parameter instability is established if the cumulative sum of the residuals goes outside the area between the two critical (dotted) lines. The CUSUM test is useful for detecting systematic changes in the regression co-efficients and the CUSUMSQ tests is useful in situations where the departures from the constancy of the regression coefficients is haphazard and sudden. Both are estimated at the 5% level. From Appendix 3 and 4, we can infer that for the period 1990 to 1998 there are no major shifts in the demand for money functions estimated for the monetary aggregates.¹⁴

For the bank of Namibia, the issue of stability has further implications. Currency boards typically apportion their foreign reserves among three accounts. They hold 30-50 percent of the assets backing their notes in a liquid reserve consisting of high quality marketable securities of the reserve currency country that mature in less than one year. They maintain 50-70 percent of the assets backing their notes in an investment reserve (an important source of profit for central banks) that comprise higher yielding securities. The split between liquid and investment

¹³ Too much reliance cannot be placed on these results in view of the limitations imposed by our lag length due to data constraints. They however remain indicative and taken along other diagnostic tests permit reliable conclusions from the results of the model.

¹⁴ Our inability to perform the other tests of stability was due to the limited number of observations.

reserve is possible because the public uses a relatively fixed proportion of notes and coins in circulation to finance day-to-day transactions and under normal circumstances, would not redeem this amount for reserve assets. A stable demand for money function could serve as a framework for estimating this fraction of money supply that is needed for transactions by the public. Finally, besides the 100 percent reserve backing apportioned to the liquid and investment reserves, Currency boards usually hold an additional amount of foreign exchange equal to approximately 5-10 percent of their note issuance, in a surplus reserve. This surplus ensured that possible capital loss on the investment reserve would never pull the total amount of foreign exchange backing below 100 percent necessary to fully guarantee all notes in circulation.

6. The Definition of Money

One of the objectives of this study was to ascertain the appropriate definition of money in Namibia. This objective is prompted by the trend in the growth of money observable for the sample period and particularly for sub-sample 1995.4 to 1998.4. A cursory look at the data as represented by fig 2 will tend to suggest that mainly movements in M1 cause changes in M2. An examination of the diagnostic statistics for the two aggregates as summarised in Table 10 will tend to confirm the superiority of the M2 aggregate over the M1 aggregate. More importantly, the forecast error statistics of the M2 variable tends to outperform the M1 aggregate. Based on this we confirm that M2 is a more appropriate definition of money than M1 in Namibia.

Table 10: Comparative Statistics for M1 and M2

| Statistics | ΔLRM1 | ΔLRM2 |
|---|---------------------|---------------------|
| R ² | 0.80 | 0.88 |
| F-Statistics | 9.55 | 8.601 |
| | | |
| Forecast Statistics (full sample) | | |
| | | |
| Root Mean Squared Error | 0.0178 | 0.0161 |
| Mean Absolute Error | 0.0137 | 0.0128 |
| Mean Absolute Percentage Error | 121.65 | 51.50 |
| Theil Inequality Coefficient | 0.216 | 0.154 |
| | | |
| Forecast Statistics (out of sample) (1996.1 to 1998.4) | | |
| | | |
| Root Mean Squared Error | 0.0322 | 0.0682 |
| Mean Absolute Error | 0.0222 | 0.0572 |
| Mean Absolute Percentage Error | 435.6 | 464.3 |
| Theil Inequality Coefficient | 0.405 | 0.703 |

7. Policy Implications of Findings

The evidence provided in this study has implications for the role of money in the Namibian economy. Specifically, two interrelated areas need more careful investigation for the conduct of monetary policy. The first has to do with the stability of the demand for money function. The weight of evidence from the error-correction model and the various tests of stability lend support to the stability of the demand for money function. A stable demand for money function is essential for the conduct of monetary policy. The other issue has to do with the role of interest rates in the economy. Our results support the fact that the rate of interest is a significant variable in determining the size and composition of the demand for money. Using the rate of return on the six-month deposits of commercial banks, we found that an increase in this rate will lead to a fall in the demand for money narrowly defined and to a switch by asset holders to quasi-money. Under normal circumstances, the policy option available to policy-makers given our results is fairly straightforward. The strategy for monetary policy would have voted in favour of a shift towards indirect monetary control with emphasis on open-market operations. Given the robustness of the estimates of broad money, an appropriate target of monetary policy would have been M2 and monetary policy impulses would have been transmitted through the medium of interest rates or monetary aggregates.

However, in our own circumstances, the practicality of these measures is highly circumscribed by the existing exchange rate arrangement. The exchange rate arrangement and the degree of capital mobility influence the choice of the targets of monetary policy. In an open economy with fixed exchange rates, the money supply is not directly controllable by the central bank since changes in the money supply can occur through monetary movements brought about by changes in balance of payments surpluses or deficits.¹⁵ Moreover, with increased capital mobility, the scope for interest rate targeting is limited. The country must rely on its interest rate policy being dictated from abroad.¹⁶ Hence it has often been suggested that in the circumstances, the appropriate target of monetary policy should be domestic credit extended by the central bank or the banking system to the economy.¹⁷ In our circumstance, a tightening of monetary policy, for instance, through changes in reserve or liquidity requirements or a reduction in bank' access to rediscount facilities, may transmit the impact of policy through interest rates to the economy, thus enabling the rate of interest to play a greater role as the channel of monetary policy. This role of interest rates in transmitting monetary impulses is however conditioned on a number of factors not the least important among which is the nature of financial markets. Where the financial markets is imperfect and severely oligopolistic as is often the case in most developing countries, what emerges is inflexible real interests rates that discourage investments, and slows economic growth.

¹⁵ *The central bank under the circumstances cannot sterilise any balance of payments imbalances since it neither holds enough securities nor foreign exchange reserves to be able to do this.*

¹⁶ *For a detailed discussion of the issues raised here see Frenkel and Johnson (1976) and IMF (1977).*

7. Conclusion

This paper has attempted to estimate a demand for money function in Namibia by employing cointegration and error correction methodology using quarterly data for the period 1990 to 1998. Our results show that real money balances, income and interest rates have stable relationships in the economy and among others income and interest rates are important determinants of money holding. A more important role for the transmission of monetary impulses by the rate of interest is thus suggested by our results. While under the present arrangements a full-scale transition to indirect monetary control might not be feasible, policies that target domestic credit availability can be focused upon while relying on interest rates to transmit the impulses generated to the larger economy. In the limit, there is no doubt that a full-scale adoption of indirect monetary policy will be the optimum. This calls for changes in the present institutional arrangement.

¹⁷ *Tseng and Corker (1991) did a fuller analysis on some selected Asian countries operating under a fixed exchange rate system prior to their transition to flexible exchange rate arrangements.*

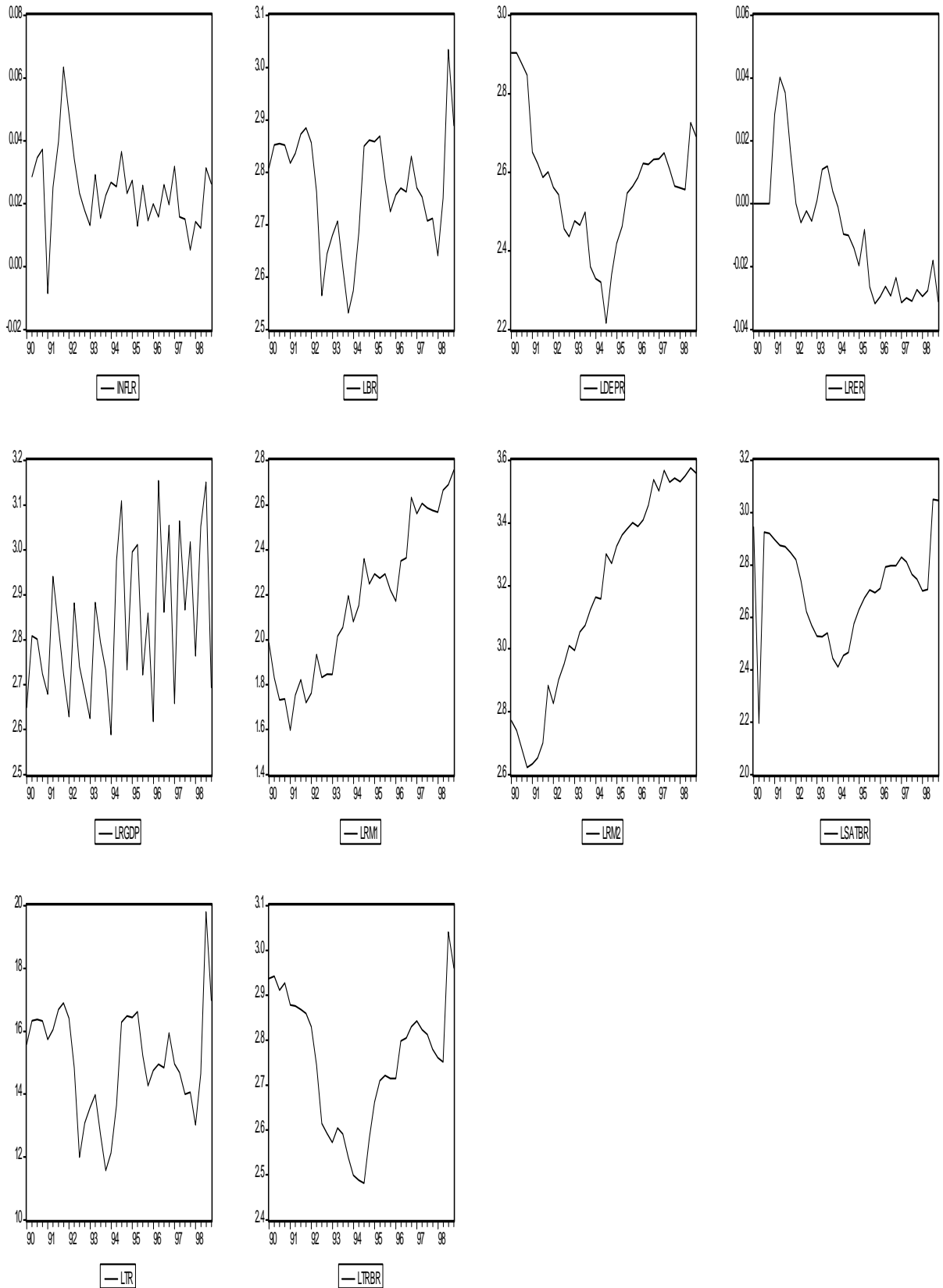
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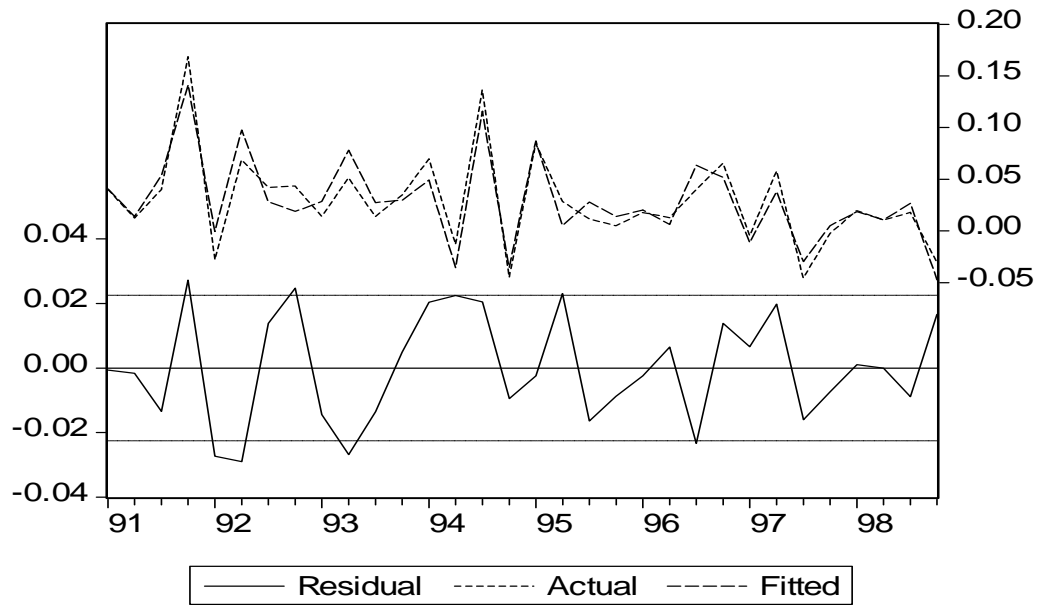
APPENDIX 1.

Figure 1: Stationarity Tests: Variables at I(0)



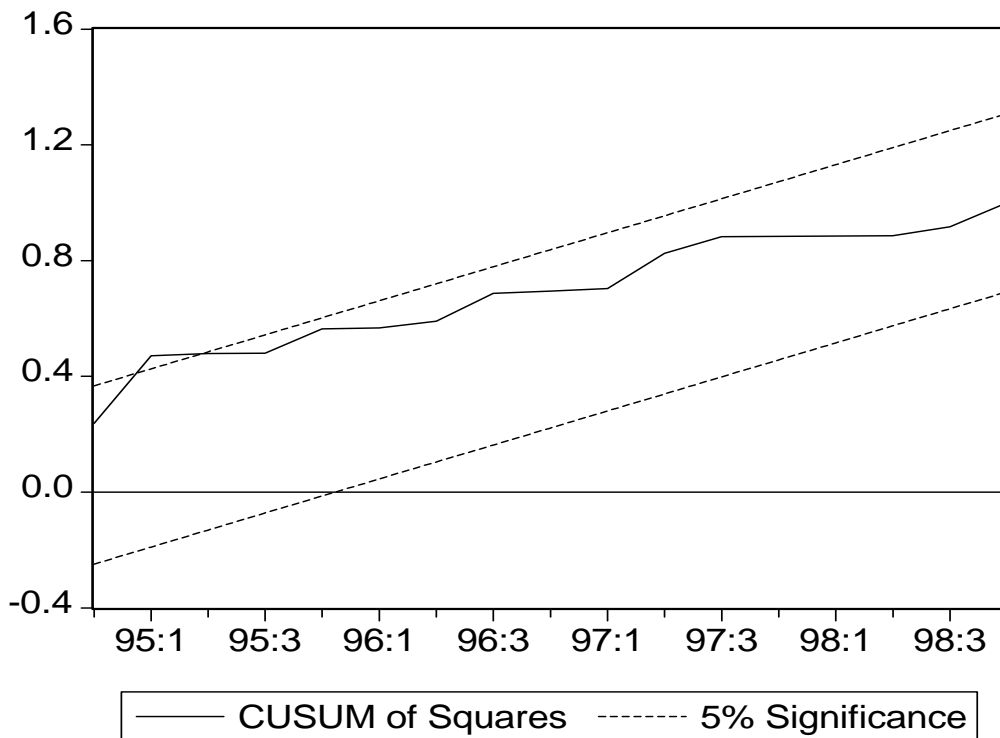
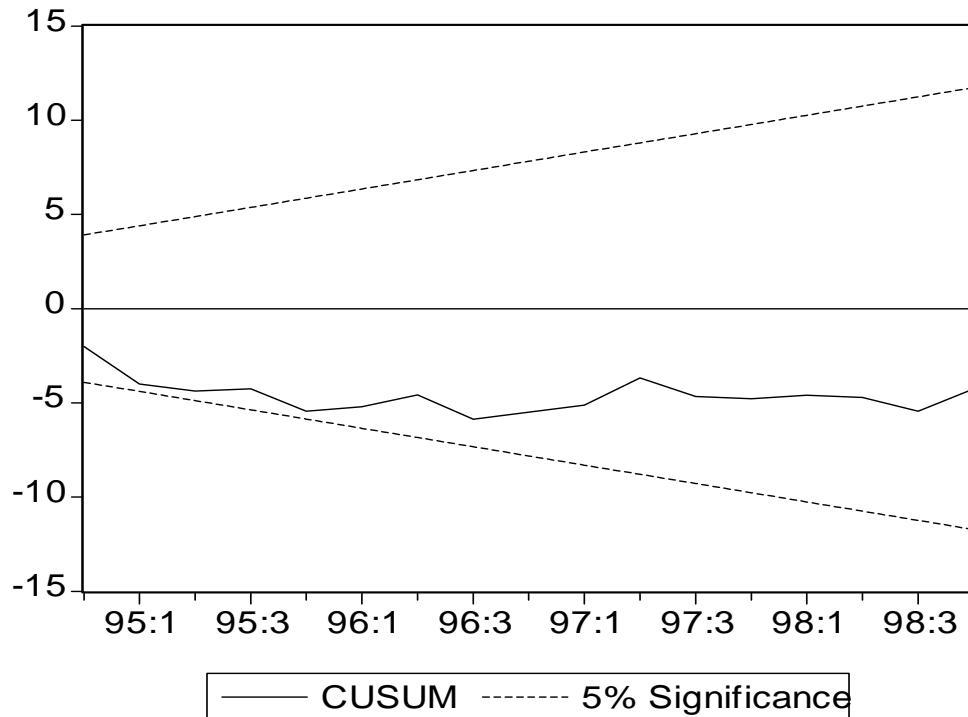
APPENDIX 2

M2: Actual Vs Fitted



APPENDIX 3.

Stability Tests M2



APPENDIX 4.

List and Description of Variables Used

| | |
|-----------|---|
| CPI: | - Namibian Consumer price index |
| BR: | - Long term bond rate |
| BR: | - BR-BR (-1) |
| DEPR: | - Deposit Rate |
| DEPR: | - DEPR-DEPR (-1) |
| INFLR: | - Inflation Rate |
| INFLR: | - INFLR-INFLR (-1) |
| ECM1: | - Error Correction term (M1) |
| ECM33: | - Error Correction term (M2) |
| ECM55: | - Error Correction term (QM) |
| RGDP: | - Real Gross Domestic Product |
| RGDP: | - RGDP-RGDP (-1) |
| LRGDPsa: | - log(RGDP-RGDP(-1) and seasonally adjusted |
| RM1: | - Real M1 (Narrow Money) |
| RM1: | - RM1-RM1 (-1) |
| LRM1sa: | - log(RM1-RM1(-1) and seasonally adjusted |
| RM2: | - Real M2 (Broad Money) |
| RM2: | - RM2-RM2 (-1) |
| LRM2sa: | - log(RM2-RM2(-1) and seasonally adjusted |
| RQM: | - Real Quasi Money |
| RQM: | - RQM-RQM (-1) |
| LQMM2RAS: | - Computed rate of return on M2 |
| SATBR: | - South African Treasury bill rate |
| SATBR: | - SATBR-SATBR (-1) |
| LSATBRsa: | - log(SATBR-SATBR(-1)) |
| RER: | - Bilateral Real Exchange Rate N\$(ZAR) |
| RER: | - RER-RER (-1) |
| LRERsa: | - log(RER-RER(-1)) |
| TRBR: | - Namibian Treasury Bill rate |
| TRBR: | - TRBR-TRBR (-1) |
| N\$: | - Namibian Dollar |
| SER2: | - Dummy Variable (M2) 1990.1 to 1993.4 = 1, 0 otherwise |
| ZAR: | - South African Rand |