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# ASYMMETRIC DETERMINANTS OF MONEY DEMAND IN NAMIBIA: THE NARDL APPROACH

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***Abstract***

*The study provides new insight on the asymmetric determinants of money demand in Namibia. The study employed a nonlinear autoregressive distributive lag (NARDL) methodology to estimate the asymmetric relationship between money demand and its explanatory variables, using quarterly data covering the period 2000Q1 to 2020Q1. The findings suggested the presence of an asymmetric long run equilibrium relationship between money demand and its explanatory variables. Both the appreciation and depreciation of the Namibia Dollar exchange rate resulted in an increase in money demand although the responsiveness leaned towards a depreciation than an appreciation of exchange rate. Moreover, money demand responds negatively to both increase and decrease in prices and interest rates. On the contrary, the results also show that increase and decrease in the values of income are associated with an increase in money demand. Given these findings and Namibia's CMA membership, the responsiveness of the demand for money to the exchange rate highlights an area of potential benefit in as far as a significant appreciation is concerned. Furthermore, significant changes in prices, real interest rate and real income have been shown to have a significant impact on the demand for money in Namibia.*

## Contents

## 1. Introduction

**Money demand is one of the most important basic elements of monetary policy**. Money is considered a central objective of why private and public sector are in operation. According to Jhingan (as cited in Umaru and Yusuf, 2018), demand for money arises from two main functions of money. It is considered to be a store of value and that it acts as a medium of exchange. Hence, businesses and individual households will hold money in both cash and in the form of assets. The demand for money is crucial in the financial sector, more specifically the central bank which is mandated to control the demand and supply of money in the economy.

**The demand for money is one of the key functions in formulating appropriate monetary policy (Özçalik 2014).** Moreover, the function of money demand is considered a basic element in the conduct of monetary policy. In this regard, it allows the central bank to target macroeconomic variables such as inflation, interest rates and even Gross Domestic Product (GDP) to maintain macroeconomic stability in the economy.

**It is authoritative that central banks understand the key aggregates of the money demand function.** Due to the important nature of the money demand function to the monetary authority, it is imperative for central banks to understand the short run and long run dynamics of the money demand function in the economy. This allows central banks to identify which variable of the money demand aggregate to control in order to effect changes in monetary policy and ultimately macroeconomic variables. In addition, understanding money demand and its aggregates allows the central bank to have knowledge on which instruments to apply during monetary policy decisions and how to meet liquidity needs in the financial sector (Umaru and Yusuf, 2018).

**A stable money demand function is a very important condition in order for the monetary authority to run an effective monetary policy.** The effectiveness of the use of the money demand function as a tool of monetary policy solely depend on whether there exist a steady and stable long and short run relationship of money demand (M2) and its key determinants. Additionally, it is theoretically required that the money demand function be stable for it to be used effectively as a monetary policy tool. It is further argued that, if a stable money demand function exists, the monetary authority of the economy may rely on it to affect important macroeconomic variables (Dritsak, 2011). Therefore, stability of money demand ensures that the monetary authorities are able to adequately estimate the effect of monetary policy on economic activities

and enable them to carry out policy actions with greater confidence and efficiency (Umaru and Yusuf, 2018).

**Money demand can serve as an important indicator of effective monetary policy and growth in an economy.** According to Dritsakis (2011), the demand for money function creates a background to review the effectiveness of monetary policies and economic growth. This is based on the fact that, an increase in the money demand mostly indicates a country's improved economic situation, as opposed to the falling demand which is normally a sign of a deteriorating economic situation (Maravić and Palić's views (as cited in Dritsak,2011). With regard to the effective monetary policy, a stable relationship between money (M2) and its determinants is a prerequisite for monitoring and targeting of monetary aggregates (Dritsak, 2011). A steady and stable long run relationship between money demand and its aggregates indicates that any of these variables can be used to the effect monetary policy stance at any point.

**There is extensive literature on the estimation of the money demand function.** However, most of the literature focuses on a stable and linear money demand function (Dogru and Recepoglu, 2013). The money demand function has been largely estimated using linear methodologies, more specifically by applying the Vector Error Correction (VEC) cointegration method (among others). However, there has been a growing trend and developments in the use of a nonlinear methodology such as Nonlinear Cointegration Least Squares" (NCLS) developed by Bae and De Jong (2007), to estimate the money demand function.

**The focus of most literature so far has been on the use of linear methodology in the estimation of money demand.** There is growth in the application of non-linear cointegration methodology in the estimation of the money demand function and its determinants. This is emphasized by Bae and De Jong (2007), that the choice of the functional form is an important aspect when it comes to results, as different functional forms have different implications for the presence of the liquidity trap and effectiveness of the traditional monetary policy.

### 1.1. Research problem

**None of the literature undertaken in Namibia on the money demand function has so far applied a non-linear cointegration methodology.** Research studies conducted on money demand in Namibia, include Ikhide & Katjomuise (1999), Mabuku, 2009, Shidhika (2015) and Sheefeni (2013). All these previous studies in Namibia have modelled the money demand function using a linear approach and none have attempted to test the nonlinear relationship between

money demand and its explanatory variables. Previous studies assumed that negative and positive values of explanatory variables have the same impact on the money demand. Based on this gap, it is important to empirically test if the money demand function is a nonlinear form.

**The literature found mixed relationships between money demand and its aggregates in Namibia.** This conclusion could be attributed to different linear methodologies applied and different estimation periods. Hence, it is important to investigate whether the relationship between money demand and its determinants is nonlinear in Namibia. As it can be observed, most of these studies were conducted more than five years ago. The Namibian economy has since observed some developments in the financial sector during the past years that may have influenced the behaviour of the money demand function. Furthermore, there has been a tremendous growth in economic literature on the methodologies used to estimate money demand, which could change the behaviour of the demand for money in Namibia. These developments provide an opportunity to further investigate the Namibian demand function. This research is the first to estimate the money demand function using the nonlinear relationship in Namibia. The purpose of this study is, to estimate a nonlinear demand for money in Namibia.

## 1.2. Research Objectives

**In the context of the above, the objective of this paper is to estimate the Namibia money demand function using a nonlinear methodology.**

The following is the specific objective of the study:

- To test the asymmetric relationship between money demand (M2) and its determinants in Namibia on real income, inflation, nominal exchange rate and interest rate, using Nonlinear Autoregressive Distributed Lag (NARDL) estimation technique.

**The rest of the paper is structured as follows.** After the introduction and objectives of the study outlined above, the paper proceeds with the review of the existing theoretical and empirical literature on demand for money in monetary economics and then discuss the non-linear functional form of the demand for money. After this, the methodology is explained in detail, followed by the presentation and discussion of the results. In the final analysis, the study concludes and provide policy recommendations and policy implications based on the findings of the study.

## 2. Review of Literature

### 2.1. Theoretical Literature

**Traditional Theories of Demand for Money**

**A range of theories exist explaining how the demand for money works in the real economy.** Understanding this will assist with assessing the possible implications that financial innovation might have on the demand for money and ultimately monetary policy. Below are some of the theoretical literature as explained in Mbazima-Lando and Manuel (2020).

***Classical theorists*** **argued that demand for money is mainly dependent on the volume of transactions in the economy and this was reflected in Fishers quantity theory of money.** According to Tillers (2004), the theory assumes that velocity of money depends on the quantity of money in circulation and nominal income of the economy. As a result, if the velocity of money is constant in the short run, the quantity of money depends on nominal income only. This is expressed as;

$V = \frac{P \cdot Y}{M}$ ..... (1)

Where; $M$ is the quantity of money; $P$ is the price level; $Y$ is the output

Assuming that velocity is constant, the function of the demand for money is specified as;

$M^d = k \cdot P \cdot Y$..... (2)

In the final analysis, the Fisher theory rejects the dependence of the demand for money on interest rates.

***Friedmann's modern quantity theory of money*** **rests on the concept that demand for monetary assets is based on various forms of wealth, tastes and preferences of asset holders and permanent income.** Interest rates were deemed to have an insignificant impact on the demand for money. Friedman's demand for money function is specified as;

$\frac{M^d}{P} = f(Y_p, r_b - r_m, r_e - r_m, \pi^e - r_m)$ ..... (3)

Where $Y_p$ is the permanent income, $r_m$ is the expected return on monetary assets, $r_b$ is the expected return on bonds; $r_e$ is the expected return on shares, $\pi^e$ is the expected inflation.

**The *Keynesian theorists* emphasise the importance of interest rates in determining the demand for money and advocate that individuals to hold money for transaction,**

**precautionary and speculative motives**. Laidler (cited in Shidhika, 2015) suggested that both transaction and precautionary motives depend on the level of income, whereas the speculative motive for holding money arises from the desire to maximise wealth and it depends on interest rates. The Keynesians specify the demand for money as:

$$M^d = kY + L(r) \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where; $M^d$ is demand for money, $kY$ is the transaction and precautionary motive which depends on the level of income $(Y)$; $L\ (r)$ is the speculative motive which depends on interest rate.

**Post-Keynesian theorists, such as the Baumol-Tobin model, view money as a medium of exchange which proves that the demand for money is dependent on the interest rate (Gonda, 2003).** As stipulated in Shidhika's 2015 study, the theoretical model assumes that individuals hold money or bonds due to the uncertainty of interest rate. In addition, the Baumol-Tobin theory highlights that an increase in income will lead to larger investments in bonds enabling the investors to enjoy the benefits of economies of scale (Shidhika, 2015). Moreover, the theory deems the transactions component of the money demand for money to be negatively related to the level of interest rates (Gonda, 2003).

### 2.2. Empirical Literature on International Case Studies

**There is extensive literature on the estimation of money demand functions in both developed and developing economies**. The results and conclusions from literature mostly point to a long run relationship between real money demand and its aggregates. The signs and conclusion of stability however vary depending on a number of factors, such as data frequency, the estimation methodology and the level of development in the economy (Dritsakis 2011).

**A long run relationship exists between demand for money and real income, the inflation rate and nominal exchange rate in Hungary**. In his study, Dritsakis (2011) examined the demand for money in Hungary, using the Autoregressive Distributed Lag (ARDL) cointegration method for a monthly period from 1995 to 2010. The results based on the bounds testing procedure confirmed that a stable long run relationship exist between demand for money and its determinants: real income, the inflation rate and nominal exchange rate in Hungary. Further, it was found that the real income elasticity coefficient was positive while the inflation rate elasticity

and nominal exchange rate were negative. Using CUSUM and CUSUMS square tests, the study revealed that the money demand function was stable over the study period.

**A long- and short run relationship also exist between M2 and interest rate as well as GDP, in Turkey**. Özçalik (2014) also examined the long run and short run dynamics of money demand with effective exchange rate, weighted interest rate of one-month term deposits and quarterly seasonally adjusted gross domestic product in Turkey. Using quarterly data between 1995Q4-2013Q3 and the ARDL approach, the study estimated the link between M2 monetary aggregate and its macroeconomics factors. The study found a long run and short run relationship between M2 and interest rate as well as GDP. Furthermore, although the CUSUM and CUSUM square tests indicated that the money demand function was stable in the first test, it was however not stable in the second test for both long run and short run.

**Similarly, Dogru and Recepoglu (2013) found long run relationship in Turkey.** The study examined the long run and short run dynamics between money demand dynamic and real GDP and nominal interest rates in Turkey. The study was based on the Keynesian liquidity preference theory of money demand using Dynamic OLS (DOLS) and Fully modified OLS (FMOLS) methods for the time period 1980-2012. The empirical results of the study showed that there is a long run relationship between inflation, exchange rates and money demand in Turkey. The study concluded that, real money demand in Turkey is positively related with income and negatively related with nominal interest rates.

**Iftekhar, Mamoon and Hassan (2016) investigated the determinants of the money demand function in Pakistan.** Their study used the interest rate, GDP per capita, exchange rate, and fiscal deficit, urban and rural population to estimate the money demand function in Pakistan. The study covered a period from 1972-2013 and applying ARDL Bound test approach in order to test the long run relationship. The results showed that the real interest rate had a significant and negative effect upon money demand in both the long run and short run. The results also indicated that exchange rate and rural population were significant but had a negative effect on the demand for money.

**GDP per capita, interest rate, exchange rate and inflation rate were found to be the main determinants of the money demand function in the five ASEAN countries.** Umaru and Yusuf (2018) investigated the determinants of the money demand function for five ASEAN countries (ASEAN-5) over the period 1987-2014. They used variables such as GDP per capita, interest rate, exchange rate, inflation rate and stock price index as independent variables, while money

demand was the dependent variable. Using panel data models such as the Pooled OLS model, Fixed Effect Model (FEM), and Random Effect Model, the results in their study concluded that all the variables except stock price index were determinants of the money demand function in the ASEAN-5. The findings also showed a stable money demand function.

**In Indonesia, cointegration was also found between real M2 and real income and interest rate.** Achsani (2010) tested the stability of money demand using monthly data for the period of 1995 to 2009 and an ARDL model for Indonesia. The findings in this study indicate that the demand for the real money aggregate is cointegrated with real income and the interest rate. The real income had a positive relationship with real money demand, both in the long- and short run. On the other hand, the interest rate had a negative impact on M2 in the short run, and a statistically insignificant relationship in the long run.

**Similarly, cointegration and stability was also found in Nepal between real M2, real income and the interest rate.** Bhatta (n.d) examined the long run stability of money demand function in Nepal, using an ARDL cointegration method with annual data ranging from 1975 to 2009. The study found that there exists a long run cointegration between money demand, interest rate and real GDP. The CUSUM and CUSUM square (CUSUMSQ) both revealed that both the long run and short run money demand functions were stable.

**The appreciation and depreciation of the Rupee was found to have an asymmetric effect on the demand for money in India both in the short- and long run**. Haider, Ganaie and Kamaiah (2017) explored the asymmetric relationship between money demand and the exchange rate in India using data for the period April 2004 to November 2015. For money demand, both narrow (M1) as well as broad (M3) monetary aggregates were used. The study employed a linear ARDL and discovered that the appreciation and depreciation of the Rupee has an asymmetric effect on the demand for money in India both in the long run and short run. The results showed that the coefficient of the positive partial sum (Ln EX+) which represents a Rupee appreciation was significant and negative, while for the negative partial sum (LnEX-) the coefficient was positive and significant. They concluded that exchange rate movement affects demand for money through the wealth effect not through the mechanism of changes in expectations.

**Ho and Saadaoui (2019) investigated the determinants of money demand in Vietnam by using both linear and nonlinear autoregressive distributed lag models (i.e., ARDL and NARDL models).** Over the period 2003Q3 to 2018Q1, the results showed that the substitution effect always dominates the wealth effect in both the short- and the long run. Facing a nominal

depreciation, domestic residents will acquire and hold more foreign currency to protect themselves from adverse exchange rate variations. Thus, the domestic money demand decreases. These results are consistent with symmetry tests and concluded that asymmetries occur mainly in the short run and are transmitted to the long run.

**The Dollar appreciation and depreciation were determined to have an asymmetric effect on the demand for money in Iran**. Bahmani-Oskooee and Bahman (2015) examined the nonlinear ARDL approach and the demand for money in Iran. The study appealed that the failure to find a significant relationship between the exchange rate and the demand for money could stem from assuming a linear dynamic adjustment process of variables toward their long run equilibrium variables. The study then introduced nonlinearity into the adjustment mechanism of the methodology and found that currency appreciation/depreciation of the Dollar did have an asymmetric effect on the demand for money in Iran.

**In the United States (US) it was found that the coefficient of the nominal interest rate obtained using NCLS estimates were larger in absolute value than estimates from the conventional linear cointegration methods.** With regard to the issue of non-linear methodology, Bae and de Jong (2007) investigated two different functional forms for the US using linear and nonlinear cointegration methods. It was believed that different functional forms have different implications on the effectiveness of the traditional monetary policy, hence the choice of the functional form is an important issue. The findings indicated that the nonlinear cointegration Least Squares (NCLS) estimates of the nominal interest rate coefficient were larger in absolute value than estimates from the conventional linear cointegration methods. This meant that in the long run, the US money demand function was more elastic in terms of the nominal interest rate than previously assumed. Secondly, the result also showed that the NCLS estimation method avoids a possible misspecification problem that may have existed in the previous literature where both linear and logarithm specifications were estimated by the conventional linear cointegration method. It was also found that the out-of-sample prediction performance for NCLS technique was superior to that of conventional linear estimation techniques.

### 2.3. Empirical Literature on Countries under a Fixed Peg Exchange Rate Regime

**The demand for money in Saudi Arabia, increases with both an appreciation and depreciation of the exchange rate in the long run.** In their research study, Mahmood and Alkhateeb (2018) investigated the asymmetrical effects of real exchange rate on the demand for

money in Saudi Arabia, a country under a fixed exchange regime to the US Dollar. The study applied a non-linear ARDL approach using annual data for a period 1968–2016. Empirical findings revealed that income and inflation had a positive and negative effects on money demand, respectively. A real appreciation of US dollar had a positive effect, while a real depreciation had a negative effect on the demand for money in Saudi Arabia. Consequently, the demand for money in the Saudi Arabian Riyal (SAR) was found to increase with both a real appreciation and real depreciation of US dollar in the long run. The study also found a stable money demand function with the theoretically expected effects of its determinants. As a result of these findings, the study recommended the use of money supply as a monetary policy instrument in Saudi Arabia. Moreover, since a higher demand for money was found to be a symbol of a higher economic activities in the country, it was advised that inflation should be controlled as it proved to have a negative effect on the demand for money in Saudi Arabia. In addition, since that demand for the SAR increased with both an exchange rate appreciation and depreciation in the long run, then the supply of SAR would have to be increased to meet the higher demand with any change in the real exchange rate. It was further recommended that, the estimated elasticities/coefficients of non-linear ARDL may be used by monetary authorities to supply the right amount of SAR for any movement of income, inflation, and real exchange rate.

**Stability of the money demand function in Cameroon served as a useful guide for the conduct of monetary policy.** Cameroon is a small open economy operating under a fixed exchange rate with the Euro and is one of the six Central African Franc (CFA) member states. The country has a high degree of international capital mobility with France. This is synonymous to Namibia which is part of the Common Monetary Area (CMA) and is pegged to the South African Rand. Knowledge about the money demand function in Cameroon was crucial to the effectiveness of monetary policy conducted at the regional level by the Banque Centrale des Etats de l' Afrique Centrale (BEAC). The accurate calibration of both long run and dynamic effects of various rates of return on the demand for money would allow inferences about the macroeconomic implications of financial liberalisation and the adoption of indirect monetary policy instruments by the BEAC. To the study's knowledge there is only one study on money demand in Cameroon, this is by Nachega (2001). The study applied a system cointegration analysis and derived an error-correction model to examine the behavior of the demand for broad money in Cameroon over the period 1963 to 1994. Variables used in the model were prices, income, and a vector of rates of return. The study identified three steady state relationships, a stable money demand function, an excess aggregate demand relationship, and the uncovered interest rate relationship under fixed

exchange rates with perfect capital mobility. Since Cameroon was under the fixed peg with France, the study further found an empirical support of PPP and the international Fisher parity between Cameroon and France. Furthermore, the stability of the short run dynamics of the broad money demand function was confirmed. The study concluded that the stability of the money demand function in Cameroon served as a useful guide for the conduct of monetary policy by the BEAC. With both inflation and interest rates imported from France, the targeted level of regional international reserves could be achieved by appropriately controlling BEAC's domestic credit.

**A stable long run relationship between M2, real GDP, CPI, real interest rate spread, and real exchange rate was found in Lesotho.** Damane, Sekantsi and Molapo (2018) tested the stability of the money demand function in Lesotho, using the autoregressive distributed lag (ARDL) bounds testing and error correction model (ECM) cointegration approach. Their study used annual data which covered a period from 1980 to 2015, using variables such as M2, real gross domestic product (GDP), Consumer Price Index (CPI), the real interest rate spread and real exchange rate. The study found strong evidence of a stable long run relationship between M2, real GDP, CPI, real interest rate spread and real exchange rate. In the long run, real GDP and real exchange rate were positively related to demand for real broad money balances, while CPI and the real interest rate spread negatively affected the demand for real broad money balances in Lesotho. Moreover, the short run findings also showed that real GDP and the inflation positively and negatively affect the demand for real broad money balances in Lesotho, respectively. The income elasticity of real money demand was greater than unity in the long run while it is close to unity in the short run. According to the study, the implication of these findings could be a heightened demand for foreign interest earning assets in the long run due to a lack of suitable alternative domestic financial assets. Government action to promote an increase in the availability of alternative domestic assets was encouraged.

**The money demand function in some selected SADC members states varied.** Asongu, Folarin and Biekpe (2019), investigated the demand for money in the proposed Southern African Monetary Union. The study used annual data for the period 1981 to 2015 from ten countries making-up part of the 16 Southern African Development Community (SADC) economies. Among these, Swaziland (Eswathini) and Lesotho who are part of the fixed peg arrangement under the CMA. The study applied the bounds test and error-correction co-integration methodology to estimate the money demand functions of these countries. The existence of a long run relationship between money demand and its determinants in six of the ten countries, including Swaziland and Lesotho was established. The results showed that in the short run, a change in inflation rate has

a significant negative effect on money demand in Botswana, Lesotho, Malawi, Seychelles and Swaziland. The results from the investigation produced mixed results across countries regarding the stability of the money demand function. The use of monetary aggregates as monetary policy instruments could only be effective when money demand is stable. The study concluded that, the instability of money demand in some countries and the lack of long run cointegration of money demand for South Africa, which is the biggest economy in the region, could undermine the effectiveness of monetary policy in the proposed union.

**Mixed findings were observed between M2 and its determinants in the long run in Namibia**. Ikhide and Katjomuise (1999) estimated the money demand function by employing a cointegration and error correction methodology using quarterly data for the period 1990 to 1998. In their final analysis, their study concluded that M2, income and interest rates had stable relationships. Similarly, Mabuku (2009), investigated the stability of money demand in Namibia using quarterly time series data from 1993 to 2006 and found that both M1 and M2 had stable long run relationships between income, interest rate, CPI and exchange rate. On the contrary, Sheefeni (2016) also examined the demand for money in Namibia by applying the ARDL methodology using quarterly data for the period 2000Q1 to 2012Q4. The study found that there is no long run relationship over the study period among the variables. Shidhika (2015) applied a VAR methodology and using data from 2000Q1 to 2013Q4 to study the effect of financial innovation on the demand for money. The results found a long run relationship between money demand and its explanatory variables. Moreover, Shidhika (2015) confirmed the stability of money demand in Namibia.

**Most of the literature consulted on Namibia investigated the money demand function by applying a linear methodology.** None of the literature in Namibia has applied the nonlinear methodology to model the money demand function in Namibia. Based on the above, it is important to test the money demand function using nonlinear methodology.

## 3. Methodology

### 3.1. Empirical model

The general theoretical money demand function includes variables such as the real money balance, real income, interest rate and exchange rate as well as inflation in some instances.

The money demand function is formulated as follows:

$$M2_t = \beta_0 + \beta_1 cpi_t + \beta_2 y_t + \beta_3 r_t + \beta_4 ext_t + \varepsilon_t \ldots\ldots \quad (5)$$

Where $M2_t$ is the real monetary balance, $y_t$ is a measure of the real income variable (GDP), $r_t$ is the nominal interest rate, $ext_t$ is real effective exchange rate, $cpi_t$ inflation and $\varepsilon_t$ is an error term.

Taking a natural log of equation 5, the money demand function is then re-written as:

$$lnM2_t = \beta_0 + \beta_1 lncpi_t + \beta_2 lny_t + \beta_3 r_t + \beta_4 ext_t + \varepsilon_t \ldots\ldots \quad (6)$$

Theoretically, it is expected that the real income coefficient has a positive effect on real money demand whereas for interest rate and inflation it has a negative effect. According to Haider *et al* (2017), the sign of the coefficient of the exchange rate is ambiguous as it may be positive or negative depending on the wealth effect or the currency substitution effect.

Equation 5 and 6 is a long run model and can be estimated by any method. Ignoring short run dynamics from a long run model could create an instability problem (Laidler, 1993, p. 175) as cited in Haider *et al* (2017). Further, in order to mitigate such a problem equation 6 can be specified to incorporate the short run dynamics such as an error correction model.

**Estimation technique**

**This study will use the nonlinear autoregressive distributive lag (NARDL) in order to evaluate the asymmetric effect of explanatory variables on money demand as specified in equation (6).** We therefore employ the NARDL model proposed by Shin *et al*. (2014) under the conditional error correction model as follows:

$$lnM_t = \beta_0 + \beta_1 lnM2_{t-1} + \beta_2^+ lncpi_{t-1}^+ + \beta_3^- lncpi_{t-1}^- + \beta_4^+ lny_{t-1}^+ + \beta_5^- lny_{t-1}^- + \beta_6^+ r_{t-1}^+ + \beta_7^- r_{t-1}^- + \beta_8^+ lnext_{t-1}^+ + \beta_9^- lnext_{t-1}^- + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (7)$$

Equation (7) is re-specified fully in NARDL form in equation (8) as follows:

$$\Delta lnM2_t = \beta_0 + \sum_{i=1}^{p0}(\beta_{0,i} . \Delta lnM_{t-i}) + \sum_{j=0}^{p_1^+}(\beta_{1,j}^+ \Delta lncpi_{t-j}^+ \ ) + \sum_{j=0}^{p_1^-}(\beta_{1,j}^- \Delta lncpi_{t-j}^- \ ) + \sum_{k=0}^{p_2^+}(\beta_{2,k}^+ \Delta lny_{t-k}^+) + \sum_{k=0}^{p_2^-}(\beta_{2,k}^- \Delta lny_{t-k}^-) + \sum_{l=0}^{p_3^+}(\beta_{3,k}^+ \Delta r_{t-l}^+) + \sum_{l=0}^{p_3^-}(\beta_{3,k}^- \Delta r_{t-l}^-) + \sum_{m=0}^{p_4^+}(\beta_{4,m}^+ \Delta ext_{t-m}^+) + \sum_{m=0}^{p_4^-}(\beta_{4,m}^- \Delta ext_{t-m}^-) + \gamma_0 lnM2_{t-1} + \gamma_1^+ lncpi_{t-1}^+ + \gamma_2^- lncpi_{t-1}^- + \gamma_3^+ lny_{t-1}^+ + \gamma_4^- lny_{t-1}^- + \gamma_5^+ r_{t-1}^+ + \gamma_6^- r_{t-1}^- + \gamma_7^+ lnext_{t-1}^+ + \gamma_8^- lnext_{t-1}^- + \varepsilon_t \ldots\ldots\ldots\ldots (8)$$

Where $p$ is lag order, and the coefficients of the long run are computed as $\beta_2 = \gamma_1^+/\gamma_0, \beta_3 = \gamma_2^-/\gamma_0,\ \beta_4 = \gamma_3^+/\gamma_0,\ \beta_5 = \gamma_4^-/\gamma_0,\ \beta_6 = \gamma_5^+/\gamma_0,\ \beta_7 = \gamma_6^-/\gamma_0,\ \beta_8 = \gamma_7^+/\gamma_0,\ \beta_9 = \gamma_8^-/\gamma_0$. The "+" and "-"notations of the explanatory variables in equation (8) are the partial sum of positive and negative changes. These are specifically expressed as follows:

$$lncpi_t^+ = \sum_{i=1}^{t} \Delta lncpi_i^+ = \sum_{i=1}^{t} \max\left(\Delta lncpi_i, 0\right)$$

$$lncpi_t^- = \sum_{i=1}^{t} \Delta lncpi_i^- = \sum_{i=1}^{t} \min\left(\Delta lncpi_i, 0\right)$$

$$lny_t^+ = \sum_{i=1}^{t} \Delta lny_i^+ = \sum_{i=1}^{t} \max\left(\Delta lny_i, 0\right)$$

$$lny_t^- = \sum_{i=1}^{t} \Delta lny_i^- = \sum_{i=1}^{t} \min\left(\Delta lny_i, 0\right)$$

$$r_t^+ = \sum_{i=1}^{t} \Delta r_i^+ = \sum_{i=1}^{t} \max\left(\Delta r_i, 0\right)$$

$$r_t^- = \sum_{i=1}^{t} \Delta r_i^- = \sum_{i=1}^{t} \min\left(r_i, 0\right)$$

$$lnext_t^+ = \sum_{i=1}^{t} \Delta lnext_i^+ = \sum_{i=1}^{t} \max\left(\Delta lnext_i, 0\right)$$

$$lnext_t^- = \sum_{i=1}^{t} \Delta lnext_i^- = \sum_{i=1}^{t} \min\left(\Delta lnext_i, 0\right)$$

Shin et al (2014) introduced the bounds testing which can be used to test for asymmetric cointegration between the variables. This is similar to the linear autoregressive distributive lag (ARDL) technique.

The null hypothesis is that the relationship is symmetrical if:

$$\gamma_1 = \gamma_2^+ = \gamma_3^- = \gamma_4^+ = \gamma_5^- = \gamma_6^+ = \gamma_7^- = \gamma_8^+ = \gamma_9^- = 0$$

The alternative hypothesis states that the relationship is asymmetrical if:

$$\gamma_1 \neq \gamma_2^+ \neq \gamma_3^- \neq \gamma_4^+ \neq \gamma_5^- \neq \gamma_6^+ \neq \gamma_7^- \neq \gamma_8^+ \neq \gamma_9^- \neq 0$$

The NARDL estimation technique uses the F-statistic and critical values in order to make a conclusion on the hypotheses. If the null hypothesis is rejected, then the relationship between money demand and its explanatory variables is asymmetrical. The diagnostic tests (such as Wald test, LM, cumulative sum of squares) need to be done in order to ensure that the results are robust.

### 3.2. Data

Quarterly data covering the period 2002Q1 to 2019Q4 is used. The data is sourced from two institutions, mainly the Bank of Namibia (BoN) and Namibia Statistics Agency (NSA). Real income (real GDP) and real money balance (M2) variables are in natural logarithm form. The data used in the estimation are summarised in Table 1.

**Table 1. Variable description**

| Variable | Variable description | Source |
|---|---|---|
| y | GDP which is a measure of income | Namibia Statistics Agency |
| M2 | Real money balance | Bank of Namibia |
| r ( nominal 3 months) | 3 months treasury bill. This is a proxy for interest rate. | Bank of Namibia |
| r (nominal 6 months) | 6 months treasury bill. This is a proxy of interest rate | Bank of Namibia |
| r ( real 3 months) | Real 3 months treasury bills rate. Computed as nominal 3 months treasury bills rate minus inflation rate | Computed by the authors |
| r (real 6 months) | Real 6 months treasury bills rate. Computed as nominal 6 months treasury bills rate minus the inflation rate | Computed by the authors |
| ext | Namibia dollar/USA dollar exchange rate | Bank of Namibia |
| cpi | Consumer price index which measures inflation rate | Namibia Statistics Agency |

Source: computed by the authors

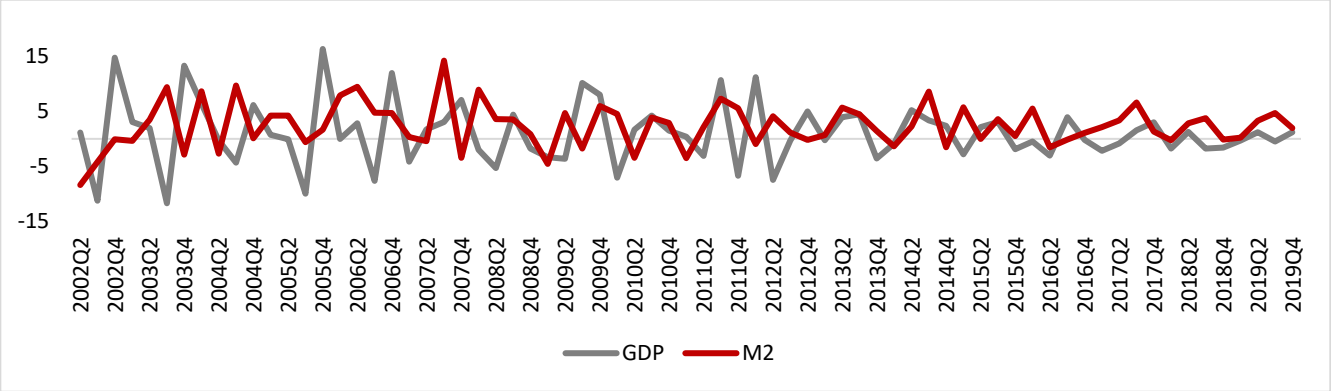
**The study uses graphs in Figure 1 (a-c) to analyse trends of the exogenous variables in relation to M2 over the period 2002-2019**. Between the period 2001 and 2008 broad money (M2) constituted of M1 which is the (currency in circulation and transferable deposits) and other deposits. In 2009, however the Money Market Unit Trusts (MMUTs) were introduced to form part of the Other Depository Corporations. Namibia's current definition of broad money (M2) includes currency in circulation, transferable deposits, other deposits, and securities issued by commercial banks, other banking institutions and MMUTs held by domestic private-sector parties. Figure 1 shows that on average M2 grew by about 3.5 percent over the entire period of analysis (2002-2019). However, between 2009Q1 and 2019Q4 M2 grew drastically by 158 percent. The major

increase in growth is mainly due to the inclusion of the MMUTs data which was initially not part of the M2 compilation.

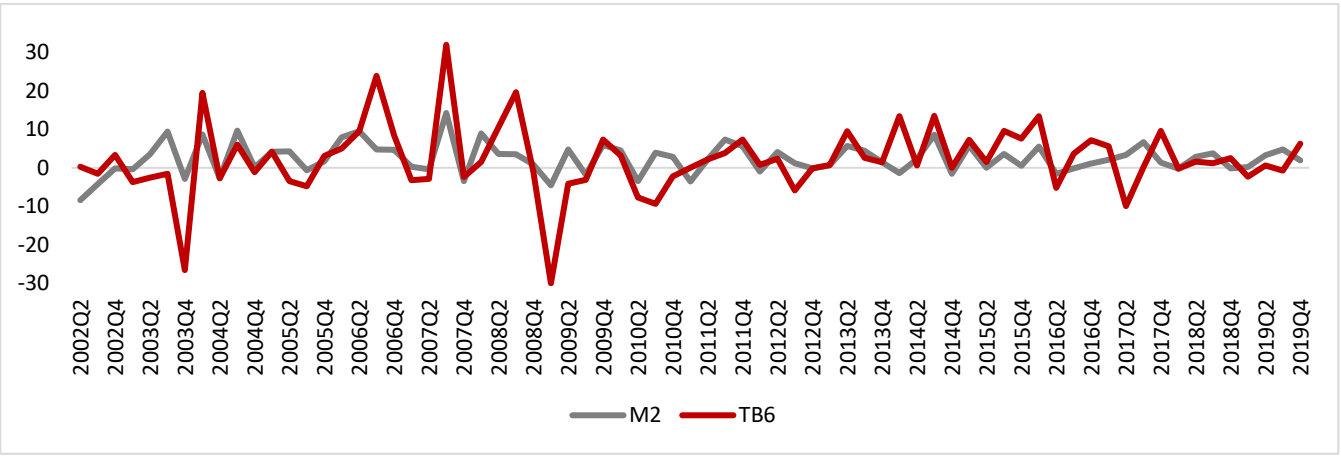
**Growth in M2 tracks the growth rates in interest rate, real GDP and CPI over the period.** Figure 1 shows the trend movements between M2 and GDP, Treasury bill (TB6) and CPI. The movements between M2 and real GDP which is a representative of real income in this study trends in similar direction. This trend confirms that an increase in the money demand can be a reflection of increases in real GDP or economic activity. Similarly, growth in M2 evidently tracks the growth rate of interest rate (TB6), this also confirms the theoretical claim of the long term relationship between money demand and interest rate. In term of prices, figure 1.c also shows that there is a certain level of interaction between CPI and M2, although the trend is quite mixed on some periods.

**Figure 1. (a-c): Growth rate in M2, CPI and Treasury Bill (TB6)**

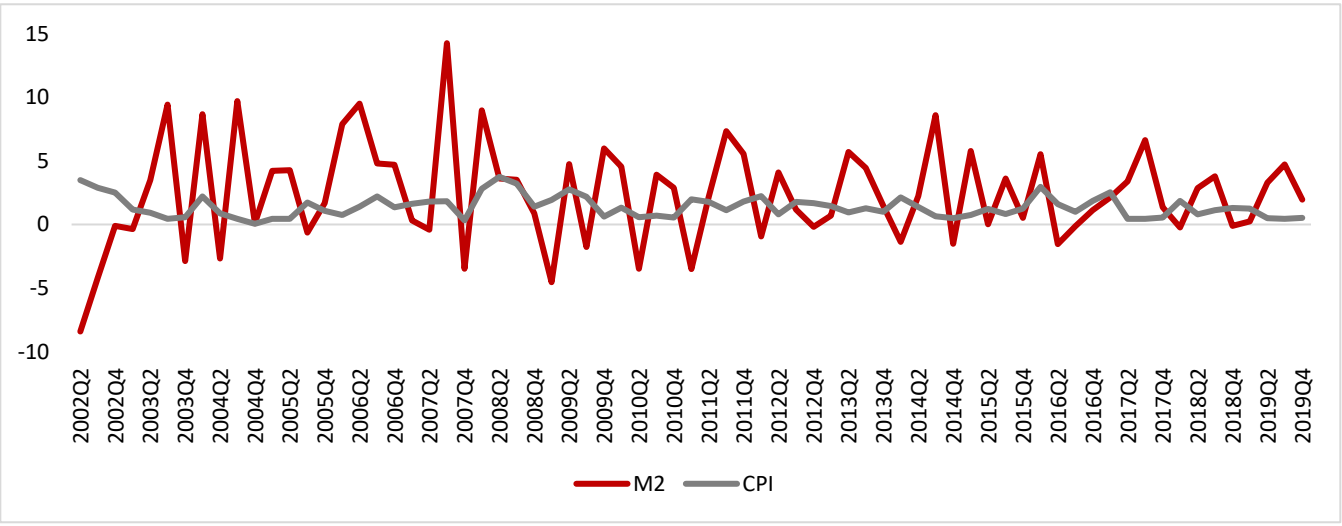
***a. Growth rate in real GDP and M2***




***b. Growth in Treasury Bill rate and M2***




***c. Growth in CPI and M2***



## 4. Empirical Results

### Descriptive Statistics

The descriptive statistics are presented in Table 2. The results show that real money balance has the highest mean. Real GDP has the lowest mean. The variables with the highest standard deviations are the interest rate and real money balance.

**Table 2. Descriptive statistics**

| | LnM2 | lnext | Lncpi | r | lny |
|---|---|---|---|---|---|
| Mean | 10.64472 | 4.712112 | 4.477275 | 7.667505 | 0.010267 |
| Maximum | 11.65561 | 4.846285 | 4.917301 | 11.95000 | 0.163686 |
| Minimum | 9.424645 | 4.544672 | 3.960813 | 5.341900 | -0.117337 |
| Std. Dev. | 0.734375 | 0.085172 | 0.295664 | 1.713807 | 0.056034 |
| Skewness | -0.357421 | -0.212964 | -0.081830 | 0.950064 | 0.370795 |
| Kurtosis | 1.640502 | 1.682633 | 1.665148 | 3.199649 | 3.629839 |
| | | | | | |
| Jarque-Bera | 7.077701 | 5.750612 | 5.425843 | 10.95104 | 2.839962 |
| Probability | 0.029047 | 0.056399 | 0.066343 | 0.004188 | 0.241719 |
| | | | | | |
| Sum | 766.4196 | 339.2721 | 322.3638 | 552.0603 | 0.739214 |
| Sum Sq. Dev. | 38.29080 | 0.515059 | 6.206638 | 208.5366 | 0.222926 |

Source: computed by the authors

### Univariate characteristics of the data

**It is important to determine the univariate characteristics of the variables before estimation of the empirical model.** Univariate characteristics of the data is the first step before estimation of the empirical model, this involves a unit root test. It is important to test for a unit root of the variables before estimation, as the NARDL methodology requires that there should be no I(2) variables in the estimation, to avoid spurious results. Hence it is important to determine the univariate characteristics of the variables before estimation of the empirical model. The unit root test results are presented in Table 3. The unit root results show that, with the exception of interest rates, all variables are nonstationary in levels and that variables become stationary on the first difference. Furthermore, there are no I(2) variables and this suggests that it is appropriate to proceed with the NARDL estimation procedure.

**Table 3. Unit root test results**

| Variable | ADF statistic | | Phillip-Perron | |
|---|---|---|---|---|
| | intercept | Intercept and trend | intercept | Intercept and trend |
| LnM2 | -0.558 | -1.542 | -0.558 | -1.513 |
| ∆LnM2 | -9.174*** | -9.154*** | -9.173*** | -9.184*** |
| lncpi | -0.939 | -1.346 | -1.538 | -1.154 |
| ∆lncpi | -5.339*** | -3.119 | -5.295*** | -5.365*** |
| lny | -2.629* | -0.436 | -1.431 | -4.629*** |
| ∆lny | -10.605*** | -11.366*** | -18.151*** | -23.962*** |
| r | -2.777* | -2.604 | -2.131 | -2.081 |
| ∆r | -6.945*** | -6.984*** | -6.882*** | -6.921*** |
| r | -2.590* | -2.206 | -2.171 | -2.025 |
| ∆r | -7.084*** | -7.233*** | -6.753*** | -6.831*** |
| ext | -0.761 | -2.765 | -1.010 | -2.825 |
| ∆ext | -6.795*** | -6.771*** | -6.775*** | -6.749*** |

Note: ***/**/* statistically significant at 1%/5%/10% significance level

∆ indicates that the variable is in first difference.

**NARDL Cointegration test results**

**Since the results presented in Table 3 indicate that the variables are I(1) and that there is no variable which is I(2), it is now appropriate to proceed with the NARDL cointegration test between money demand and its explanatory variables.** The results of NARDL cointegration test are presented in Table 4. The results in Table 4 show that the null hypothesis of no cointegration is rejected at all significance levels. The F-test statistic is statically significant at al significance levels. That means that there is a nonlinear cointegration between money demand and the explanatory variables.

**Table 4. NARDL cointegration test**

| Model | F-statistics | 1% critical value | | 5% critical value | | 10% critical value | |
|---|---|---|---|---|---|---|---|
| | | I(0) | I(1) | I(0) | I(1) | I(0) | 1(1) |
| Model 1 | 18.714*** | 3.74 | 5.06 | 2.86 | 4.01 | 2.45 | 3.52 |
| Model 2 | 9.794*** | 3.74 | 5.06 | 2.86 | 4.01 | 2.45 | 3.52 |
| Model 3 | 4.489** | 3.74 | 5.06 | 2.86 | 4.01 | 2.45 | 3.52 |
| Model 4 | 8.304*** | 3.74 | 5.06 | 2.86 | 4.01 | 2.45 | 3.52 |

Note: ***/**/* statistically significant at 1%/5%/10% significance level

Model 1 uses nominal 3 months treasury bill as a proxy for interest rate

Model 2 uses nominal 6 months treasury bill as a proxy for interest rate

Model 3 uses real 3 months treasury bill as a proxy for interest rate

Model 4 uses real 6 months treasury bill as a proxy for interest rate

### NARDL long run estimation results

The NARDL long run results are presented in Table 5. The two most significant models are chosen and discussed in this section while the latter 2 are discussed in the annex. Model 1 uses the nominal 3 months treasury bill as proxy of interest rate, while model 2 uses nominal 6 months treasury bills as a proxy for interest rate. Model 3 uses real 3 months treasury bills rate, while model 4 uses real 6 months treasury bills rate as a proxy of the interest rate.

**Table 5. NARDL long run estimation results**

| Variables | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | Coefficient | t-statistics | coefficient | t-statistic |
| Intercept | 7.449 | 10.021*** | 15.799 | 8.844*** |
| LnM2 | -0.805 | -9.976*** | -1.683 | -8.845*** |
| Lnext_P-1 | 0.029 | 5.666*** | -0.007 | -1.086 |
| Lnext_N-1 | -0.130 | -10.798*** | -0.131 | -4.680*** |
| Lnp_P-1 | -0.170 | 10.429*** | -0.055 | -2.629** |
| Lnp_N-1 | 0.036 | 4.187*** | 0.014 | 0.652 |
| r_P-1 | -0.039 | -5.184*** | -0.065 | -3.898*** |
| r_N-1 | 0.115 | 11.697*** | 0.126 | 5.149*** |
| Lny_P-1 | 0.288 | 2.058** | 0.338 | 1.239 |
| Lny_N-1 | -2.047 | -7.639*** | 0.019 | 0.043 |
| R-squared | 0.953 | | 0.951 | |
| Adjusted R-squared | 0.895 | | 0.867 | |

Note: Model 1 uses nominal 3 months treasury bills rate as a proxy of interest rate. Model 2 uses nominal 6 months as a proxy of interest rate. Model 3 uses real 3 months interest rate as a proxy for interest rate. The real six months interest rate is used as a measure of interest rate in model 4.

***/**/* statistically significant at 1%/5%/10% significance level

*Source: Authors own compilation*

**Money demand is more responsive to a decrease in exchange rate than to an increase in exchange rate.** Model 1 indicates that an increase in the exchange rate has a positive coefficient of 0.029 and a decrease in the exchange rate has a negative coefficient of 0.130. These two coefficients are statistically significant. That means an increase in the exchange rate (appreciation of foreign currency) will cause money demand to increase by 0.029 percent, this result corroborates the existence of wealth effect on aggregate demand in Namibia. This implies that Namibia's foreign assets valued in US Dollar terms will tend to increase with a real appreciation of the US Dollar for example. This may be justified by the fact that the value of foreign currency tends to increase when the demand for money increases. The decrease in the exchange rate (depreciation of foreign currency) will cause money demand to also increase by 0.130 percent. This according to Mahmood & Alkhateeb (2018) is evidence of the existence of a substitution

effect or an expectation hypothesis. It indicates that a real depreciation of US dollar increases people's expectations of a further depreciation of the dollar, as a result, the demand for foreign currency reduces and the demand for domestic currency increases.

Contrary to these, Model 2 shows that an increase in exchange rate causes money demand to decrease by 0.007 percent, while a one percent decrease in exchange rate causes money demand to increase by 0.131 percent. However, the coefficient of positive values of exchange rate is not statistically significant in model 2. The results of both model 1 and 2 show that the response of money demand to an increase in exchange rate is lower than its response to a decrease in exchange rate. Money demand is more responsive to a decrease in exchange rate than to an increase in exchange rate.

**The results indicate that an increase and decrease in prices causes money demand to decrease.** Model 1 shows that increase in prices has a negative coefficient of 0.170, while decrease in prices has a positive coefficient of 0.036. The coefficients are all statistically significant. The results imply that increase in prices by 1 percent causes money demand to decrease by 0.170 percent. The coefficient of negative values of price shows that a decrease in price by 1 percent is associated with a decrease in money demand by 0.036 percent. Similarly, Model 2 shows that increase in prices by 1 percent causes money demand to decrease by 0.055 percent. The coefficient of negative values of prices is not statistically significant. These results reveal that increase in prices results in residents to demand less cash and the preference of real assets portfolio in the country.

**Both positive and negative value of interest rate cause money demand to decline.** The coefficient of the interest rate in all models is statistically significant. Model 1 and 2 both show that an increase in the interest rate by 1 percent causes money demand to decrease by 0.039 and 0.065 percent for the positive and negative changes, respectively. This is expected as a high interest rate provide an incentive to hold money in high earning portfolio assets and as a result reduce the demand for money. A decrease in interest rate by 1 percent causes money demand to decrease by 0.115 and 0.126 percent for the positive and negative changes, respectively. This could be attributed to less developed financial sector in Namibia as compared to some of its neighboring economies. The results show that money demand responds negatively to both negative and positive values of nominal interest rate in Namibia.

**All estimated models show that an increase and decrease in income is associated with an increase in money demand.** Model 1 shows that increases in income by 1 percent cause money demand to increase 0.288 percent. A decrease in income by 1 percent will result in money demand increasing by 2.047 percent, both coefficients are statistically significant. The coefficients of model 2 show that increases in income by 1 percent cause money demand to increase 0.338 percent while decrease in income by 1 percent will result in money demand increasing by 0.019 percent, both coefficients are, however statistically insignificant. Both results show that both the negative and positive value of income increase the demand for money, this implies that an expansion in income results in the need to increase demand for money. In Namibia, this could be attributed to Namibia being a consumption economy in which the ratio of final consumption expenditure to GDP was 98.2 percent according to 2019 annual national account data.

**Presence of asymmetry**

**The study established the presence of asymmetry in the long run model.** It is important to mention that both positive (increase) and negative (decrease) changes have effects on the dependent variable which is money demand. However, it raises an important question of whether the effect of positive and negative values are different. The asymmetry test is used to determine whether the coefficients from positive and negative values of explanatory variables are similar or not. If they are equal or similar, then there is no asymmetry. If they are not similar, then there is evidence of asymmetry. The results from this study rejected the null hypothesis of equality (symmetry) at 5 percent significance level. The Wald test results indicate that there is asymmetry in the long run impact of explanatory variables on money demand. The results passed all diagnostic statistics. The diagnostic statistics are not presented here but can be obtained from the authors on request.

## 5. Conclusion

**This study investigated the determinants of money demand in Namibia using quarterly data for the period 2000 to 2019.** The investigation was conducted through an extensive review of the theoretical and empirical literature. The study differs from previous research in the sense that is uses a nonlinear approach to assess the determinants of money demand. The NARDL approach was used to estimate the nonlinear relationship between money demand and its explanatory variables. This helped to establish whether there is an existence of an asymmetric relationship between the variables.

**The results indicate that there is a nonlinear cointegration relationship between money demand and its explanatory variables.** This suggests that there is an asymmetric long run equilibrium relationship between the variables. The results indicate that an increase or depreciation of the exchange rate causes money demand to increase, while a decrease or appreciation of the exchange rate causes an increase in money demand. The money demand is more responsive to decrease in exchange rate than increase in exchange rate. Moreover, the increase in prices causes money demand to decrease, while decrease in prices is also associated with decrease in money demand. An increase in the interest rate causes money demand to decrease. In this regard, money demand decreases in response to an increase in the positive values of interest rate. The results suggest that money demand is more responsive to positive values than to negative values of interest rates.

**The results also show that positive (increase) and negative (decrease) values in income are associated with an increase in money demand.** The results were subjected to an asymmetry test that confirmed the presence of an asymmetric relationship between money demand and its explanatory variables. The results conclude that all variables, exchange rate, interest rates, prices and income are the asymmetric determinants of money demand in Namibia. Results further suggest that modelling money demand in this way provides an enhanced view of how the decomposed explanatory variables bilaterally respond to the dependent variable.

## 6. Policy Implications and Recommendations

- The NARDL methodology proves useful to policy makers as it enables a deeper understanding on how the demand for money responds to its various explanatory variables. The results have shown that, in the case of Namibia, an asymmetric long-run relationship exists between the demand for money and its explanatory variables. This implies that the demand for money responds differently to positive and negative values of its explanatory variables. Given the results of this paper and Namibia's CMA membership, the positive responsiveness of the demand for money to the exchange rate highlights an area of potential benefit in as far as a significant appreciation is concerned.

- In this regard, in instances where Namibia has observed a consistent net asset position over the medium to long-term via its international investment position (IIP), the increase in foreign valued portfolios can be viewed as a gain towards the country's international

liquidity. This is due to the inclusion of such portfolio assets that have been built up abroad in the technical assessment of reserve adequacy among central banks. In this regard, such foreign assets could serve as potential international liquidity buffers in times of extraordinary and extreme economic downturns that may warrant their use. Hence, it becomes vital to ensure that both monetary and fiscal policy complement each other to ensure the appropriate policy responses work to rather preserve the country's reserves and international liquidity.

- Furthermore, significant increases in prices and significant decreases in the real interest rate and real income have been shown to have a significant impact on the demand for money. This suggests that it remains important for monetary authorities to exercise caution with their policy responses over time given the workings of the monetary policy transmission mechanism. This is because prolonged and consistent episodes of high inflation, very low interest rates and low real income may significantly impact the real economy over time. The timing of and sensitivity to policy responses becomes important and may necessitate the use of forward guidance by the monetary authority.

- Although the focus of Namibia's existing monetary policy is not a monetary targeting regime, it is still important to understand the determinants of the demand for money. The findings on the asymmetric coefficients of this study can be used to complement the existing monetary policy given the responsiveness of the demand for money to changes in income, prices, the exchange rate and the interest rate.

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## 8. Annex

### Table 5. NARDL long run estimation results

| Variables | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | coefficient | t-statistic | coefficient | t-statistic |
| Intercept | 7.510 | 5.510*** | 11.041 | 7.495*** |
| LnM2 | -0.814 | -5.442*** | -1.842 | -7.450*** |
| Lnext_P-1 | 0.006 | 0.835 | 0.003 | 0.375 |
| Lnext_N-1 | 0.016 | .0.900 | -0.008 | -0.520 |
| Lnp_P-1 | -0.006 | -0.418 | 0.013 | 0.850 |
| Lnp_N-1 | -0.082 | -2.924*** | -0.037 | -1.941** |
| r_P-1 | -0.103 | -3.978*** | -0.094 | -6.107*** |
| r_N-1 | 0.034 | 2.400** | 0.035 | 2.884*** |
| Lny_P-1 | 0.067 | 0.306 | 0.203 | 1.412 |
| Lny_N-1 | 0.358 | 0.725 | 0.384 | 1.783* |
| | | | | |
| R-squared | 0.863 | | 0.813 | |
| Adjusted R-squared | 0.678 | | 0.677 | |

Note: Model 1 uses nominal 3 months treasury bills rate as a proxy of interest rate. Model 2 uses nominal 6 months as a proxy of interest rate. Model 3 uses real 3 months interest rate as a proxy for interest rate. The real six months interest rate is used as a measure of interest rate in model 4.

***/**/* statistically significant at 1%/5%/10% significance level

Source: Authors own compilation

- Model 3 shows that the coefficients of the exchange rate are all positive (0.006 and 0.016). This suggests that increase in exchange rate by 1 percent will cause the money demand to increase by 0.006 percent. A decrease in exchange rate by 1 percent is associated with a decrease in money demand by 0.016 percent. However, the coefficients are statistically insignificant. Model 4 shows that positive values of exchange rate are associated with an increase in money demand while the negative value of the exchange rate is associated with an increase in money demand. Both these coefficients are, however, also statistically insignificant. Model 3 and 4 show that using real interest rate as proxy for the interest rate, the exchange rate becomes an insignificant determinant of money demand.

- Model 3 and 4 show that the coefficients of positive values of prices are not statistically significant. These models show that negative values of prices are associated with an increase in money demand. The coefficients of negative values in models 3 and 4 are statistically significant.

- Model 3 and 4 also shows that a 1 percent increase in interest rate is associated with a decrease in money demand by 0.103 and 0.094 percent. Negative values are associated with a decrease in money demand. Model 3 and 4 also show that decrease in interest rate

by 1 percent causes money demand to decrease by 0.034 and 0.035 percent. However, money demand is more responsive to positive values when real interest rate is used as in model 3 and 4.

- Both positive and negative value of income in models 3 and 4 have positive effects on money demand, but both coefficients are statistically insignificant. Model 4 shows that the coefficient of negative values is statistically significant at 10 percent level. It shows that a decrease in income is associated with a decrease in money demand by 0.384 percent.