ASSESSING THE ASYMMETRIC IMPLICATIONS OF THE COMMON MONETARY AREA ON THE STABILITY OF THE NAMIBIAN MONEY DEMAND FUNCTION

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DOUGHLAS MWANGALA NDANA

201207520

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MAIN SUPERVISOR: DR. CANICIO DZINGIRAI (UNIVERSITY OF NAMIBIA)

ABSTRACT

The anecdote of this study is broadly focused on assessing the asymmetric implications of the Common Monetary Area (CMA) on the stability of the Namibian money demand function (MDF) using a nonlinear autoregressive distributed lag (NARDL) model covering the period 2001q1 to 2021q3. It is provoked by long extant literature's recognition that MDF stability is a prerequisite for effective and successful monetary policy implementation. Surprisingly antecedent global and Namibian research results have remained broadly divergent, with the adoption of appropriate models, particularly nonlinear models found to be sparse. A local study that investigated the nonlinear drivers of money demand failed to ascertain the stability of the Namibian MDF, hence, the present research seeks establish the asymmetric impact of the CMA on the Namibian MDF, and ascertain the stability of the function. The results reveal the existence of a long-run relationship between money demand and the South African repo rate (SA_repo), income, three-month TB rate, inflation rate, exchange rate and deposit rate. It has been further found that long-run asymmetric impacts of most variables on the Namibian MDF are incomplete. Focusing on the main thrust of the study, positive shocks in the SA_repo, a CMA proxy, have a significant asymmetric influence on MDF in the long-run. Short-run results of the model are corroborated by a negative and statistically significant error correction term indicating that 23% of short-run deviations are corrected in each quarter over the sample period. The study further show that the short-run effects of most regressors are asymmetric and that the Namibian MDF is stable. The asymmetric dynamic multiplier effects of the SA_repo on the Namibian MDF reveals that positive shocks in the variable dominate their negative counterparts with the impact more pronounced in the long-run. Therefore, as an antidote, in its monetary policy implementation, the Bank of Namibia should vigorously observe upward adjustments in the SA_repo.

Keywords: Money demand function stability, Namibia, Asymmetry, Nonlinear Autoregressive Distributed Lag Model, Common Monetary Area

DECLARATION

I, **Doughlas Mwangala Ndana**, hereby declare that this study is a true reflection of my own research and that this work or part thereof has not been submitted for a degree in any institution.

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…………………………………… April 2023 …………………………

Doughlas Mwangala Ndana Date

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DEDICATION

This thesis is dedicated to my mother for her unwavering support, encouragement, and sacrifices. Thank you, Mama, for maintaining a solid character throughout all the adversities.

LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag Model
BIC	Bayesian Information Criterion
BoN	Bank of Namibia
CMA	Common Monetary Area
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Squares
DF	Dickey-Fuller
ECM	Error Correction Method
FPE	Final Prediction Error
GDP	Gross Domestic Product
HQC	Hannan-Quinn Criterion
IT	Inflation Targeting
LNE	Lesotho, Namibia, and Eswatini
MDF	Money Demand Function
MPC	Monetary Policy Committee
NARDL	Nonlinear Autoregressive Distributed Lag Model
NSA	Namibia Statistics Agency
PP	Phillips-Perron
QTM	Quantity Theory of Money
repo	Repurchase Rate
RGDP	Real Gross Domestic Product
RMA	Rand Currency Area
SA	South Africa
SARB	South Africa Reserve Bank
SIC	Schwarz Information Criterion
VECM	Vector Error Correction Model
ZAR	South African Rand

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CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

The examination of the stability of the money demand function continues to receive great attention in both academic and policy discourses. Stability in the money demand function ensures that the impact of changes in money supply on macroeconomic variables such as real output, inflation, and interest rates can be predicted, and hence it is a requirement for effective and successful monetary policy implementation (Harerimana & Kumar, 2021; Saed1 & Al-Shawaqfeh, 2017; Kapingura, 2014; Okonkwo et al., 2014; Bhatta, 2013). Additionally, the debate has been revitalised by the advent of the 2007–2009 financial crisis as the liquidity preferences of private actors have manifested their importance in money demand (Barigozzi & Conti, 2018; Kayongo & Guloba, 2018). The debate also extends to assessing whether money demand could be essential in signalling financial imbalances (Barigozzi & Conti, 2018).

To understand the importance of the demand for money and its stability to the general economy a s well as its implications for monetary policy formulation, it is crucial to understand what money is. People use the word *money* in their daily conversations, but it can mean numerous things. To economists, it has a specific meaning. It is defined as anything that is generally accepted as a means of payment for goods and services or in settling a debt (Mishkin, 2011). Money is thus a measure of all things in the economy since it is accepted in exchange for goods and services.

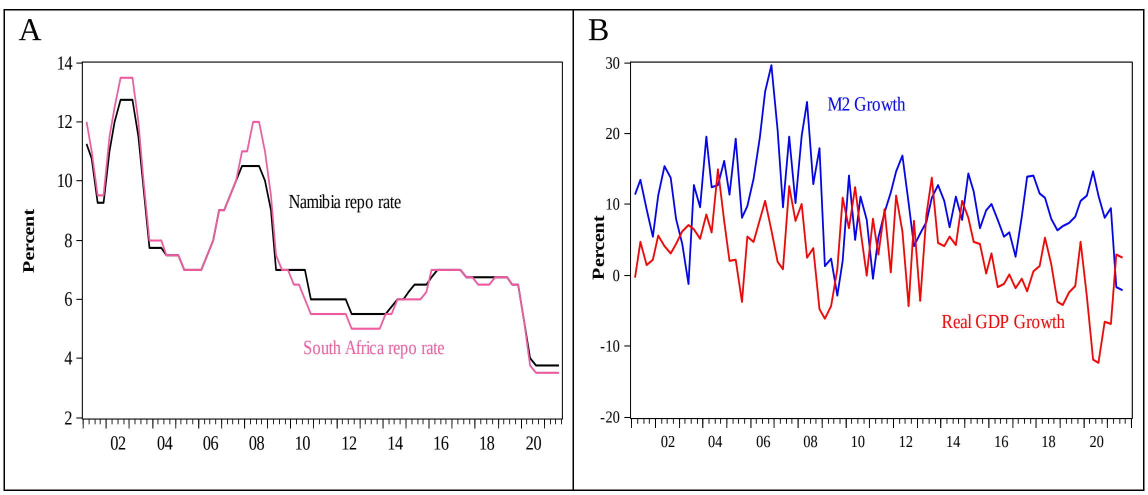
Stability in the money demand function means the quantity of money can be predictably related to a small set of variables linking money to the real economy (Harerimana & Kumar, 2021). Based on this argument, these authors and many others, including Al Rasasi (2020), Saed1 and Al-Shawaqfeh, (2017) as well as Doguwa et al. (2014), suggest that stable money demand is a necessary precondition for effective and appropriate monetary policy implementation.

At independence in 1990, Namibia adopted a fixed exchange rate regime through its membership in the Common Monetary Area (CMA) in which South Africa (SA) and the South African Rand (ZAR) are the anchor country and currency, respectively. Namibia's monetary policy formulation is thus underpinned by a fixed exchange rate in which the Namibia Dollar is pegged one-for-one to the ZAR (Bank of Namibia, 2020).

Namibia's monetary policy implementation is broadly submissive to maintaining the parity between its currency and that of SA as the primary objective of the Monetary Policy Committee (MPC) of the Bank of Namibia (BoN) continues to be safeguarding the said parity (Bank of Namibia, 2020). This is clear from Figure 1.1(A) which shows that for most of the period 2001q1 to 2021q3, Namibia's Repurchase (repo) rate is equal to or remains slightly above that of SA largely to prevent significant capital outflows. This echoes the argument by Ikhide and Uanguta (2010), who states that the nature of capital flight among the CMA countries is mostly unidirectional, particularly from the smaller member states to SA.

Figure 1.1(B) shows the growth rates in M2 and Gross Domestic Product (GDP) from 2001q1 to 2021q3. Although the two seem to track each other, real GDP growth receded since the global financial crisis of 2007–2009, growing only by 2.0% per annum compared to 5.1% prior to the crisis. Also, of much interest is the higher volatility of M2 compared to real GDP. Given the persistently subdued growth in GDP, it can be concluded that monetary policy has not effectively supported fiscal policy to bring about domestic economic growth. This is especially true considering fiscal consolidation measures by the Namibian government, which began in the 2016/17 fiscal year to regain fiscal space. The post-crisis trend in the growth rates of M2 and real GDP seems to support Keynes' preference for fiscal policy over monetary policy as a stabilisation policy in the economy during the early 1940s and 1950s. Keynes believed that monetary policy was unreliable given the instability of the speculative demand for money function (Handa, 2009). In comparison to SA, the picture is not so different as real GDP growth continued to trend downwards although stable, while money supply trended upwards since the recent financial crisis, Appendix 1.

Figure 1.1: Namibia and South Africa Repo Rate and Namibia Real M2 and Real GDP



Source: Author's construct; underlying data from BoN and Namibia Statistics Agency.

1.1.1 Monetary Policy Implementation in Namibia

The ultimate objective of monetary policy across the world is price stability. In the past, countries adopted different strategies to achieve this objective although many have progressively adopted the Inflation Targeting (IT) strategy since the 1990s. New Zealand became the first country to formally adopt IT in 1990, followed by Canada, the United

Kingdom, Finland, Sweden, and Australia in 1991, 1992, 1993, and 1994, respectively (Mishkin, 2011).

In the case of Namibia, the ultimate objective of price stability is achieved through the exchange rate targeting strategy, which involves maintaining the one-to-one parity between the Namibia Dollar and the ZAR. This parity is threatened by, among others, significant divergence in interest rates between the two countries, resulting in undue capital inflows and outflows or deviations in macroeconomic developments between Namibia and SA. By maintaining parity, Namibia imports stable inflation from the anchor country (Bank of Namibia, 2020).

Namibia does not have a formal operational target in relation to monetary policy implementation. An operational target is an economic variable that the central bank intends to influence, especially daily, through its monetary policy instruments. Notwithstanding, the Bank of Namibia monitors its official international reserve levels in line with the requirement of the fixed exchange rate regime that the country operates under (Bank of Namibia, 2020).

To influence monetary conditions in Namibia, the Bank of Namibia's main monetary policy tool is the repo rate. This is the rate at which commercial banks borrow money from the central bank, which in turn, affects other rates of interest in the local economy in pursuance of achieving operational targets. In this regard, the MPC of the Bank of Namibia meets on a bimonthly basis to decide on Namibia's monetary policy stance. The decision is taken following a thorough review of global, regional, and domestic economic and financial developments. However, this decision remains broadly in line with that taken by the MPC of the South Africa Reserve Bank (SARB).

The Bank of Namibia also uses other operational tools such as settlement accounts held by commercial banks with the central bank. The central bank also uses repurchase transactions such as the seven-day repo, the overnight repo, and the intraday repo, which are meant to assist commercial banks in meeting their short-term liquidity requirements. It further utilises the Bank of Namibia bills which were first introduced in 2007. Although these bills were initially meant to assist commercial banks in meeting their statutory liquidity requirements, they have been extended for general industry liquidity management over the years. Finally, the central bank may withdraw surplus liquidity and/or inject liquidity in the case of shortages in the market through open market operations.

1.1.2 Monetary Policy Implementation in the CMA

The CMA is a monetary union that includes SA, Eswatini, Lesotho and Namibia. The union was initially formalised in 1974 as the Rand Currency Area (RMA) between SA, Botswana, Lesotho, and Eswatini[1]. A year later, Botswana withdrew its membership (Ndzinisa et al., 2021). The need to gain the ability to formulate and implement its own monetary policy and to adjust the exchange rate, if necessary, amid shocks that may affect its domestic economy led to Botswana's exit from the RMA (Seleteng, 2013). In 1986, the RMA was renamed to what is known today as the CMA, with Namibia joining the monetary union in 1990. As a multilateral agreement, the CMA provides a framework for a fixed exchange rate between the ZAR and the currencies of the three smaller member states.

[1] Prior to 19th April 2018, Eswatini was known as Swaziland.

Under the terms of the CMA arrangement, the respective currencies of Lesotho, Namibia, and Eswatini (LNE countries) are pegged one-to-one to the ZAR, which is designated as the anchor currency. Although the LNE countries can issue their own currencies, the ZAR is allowed to circulate as legal tender in their jurisdictions. Because of this, the LNE countries receive compensatory payments, termed Rand seigniorage (Ndzinisa et al., 2021 and Seleteng, 2013). Compared to other monetary unions, like the Euro area, one may conclude that the CMA is not a fully-fledged monetary union. This is chiefly due to the absence of a common central bank, a common pool of reserves, and regional surveillance of domestic fiscal and structural policies. Moreover, South Africa's dominance over the LNE countries in terms of GDP, trade, and population stands out as a striking feature of the union. As a result, monetary policy implementation in the CMA is dictated by South Africa.

The CMA arrangement allows for deviations in monetary policy stances between the anchor country and the LNEs. However, the free movement of capital within the CMA combined with the need to maintain the parity of the LNEs' currencies to the ZAR, monetary policy stances in these countries are highly dependent on the stances on those observed in SA. It can therefore be argued that monetary policy formulation and implementation in the CMA is determined by SA with the smaller member states aligning their policies to that of SA. This view echoes those of Wang et al. (2007) who indicated that the synchronised movements of central bank rates among the CMA countries suggest that a de facto single monetary policy effectively set by the SARB is operative throughout the CMA. Ikhide and Uanguta (2010) further cemented this notion in their conclusion that SA's policy rate was the only relevant policy instrument in the CMA.

1.2 Problem Statement

As a member of the CMA, Namibia has largely lost its monetary autonomy to address domestic economic problems. However, it can still deviate to some extent from South Africa's monetary policy stance to control domestic inflation and improve economic growth. This is expected to augment fiscal policy to induce growth and/or stabilise the economy. The Namibian economy has however recorded dwindling real growth rates over the past decade, while broad unemployment remained high at 33.4% in 2018 (Namibia Statistics Agency, 2018). Although studies have been conducted on money demand in Namibia, results pertaining to the stability of the money demand function have diverged. Earlier studies (Mabuku, 2009 and Ikhide & Katjomuise, 1999) and a recent one (Shidhika, 2015) establish stability in the Namibian money demand function (MDF). Meanwhile, other works in the past decade have found that the function was unstable (Mbazima-Lando & Manuel, 2020 and Sheefeni, 2013). These studies modelled money demand as a linear function of, among others, output, and interest rates, hence failing to recognise that negative and positive shocks in the regressors may not have the same impact on money demand. Moreover, past studies have failed to consider the impact of the CMA on the stability of Namibia's MDF.

Manuel et al. (2020) were the first to explore the possibility of an asymmetric relationship between money supply and its determinants but assumed stability in their demand function. This study will thus not only revisit the Nonlinear ARDL but go a step further to test for stability in the Namibian MDF. At the heart of this study is the empirical establishment of how the CMA, particularly through monetary policy implementation, impacts stability in the Namibian MDF. Like its counterparts, BoN's objective is to promote monetary stability and to contribute towards financial stability conducive to sustainable economic development and contribute to economic growth. The role of monetary policy towards economic growth remains questionable considering the subdued economic growth rates recorded, especially since the commencement of fiscal consolidation measures in the 2016/17 fiscal year due to, among others, the need to recreate fiscal space. This is consistent with Wang et al. (2007) who asserted that the main tool for macroeconomic stabilisation in the small CMA countries was fiscal policy.

1.3 Research Objectives

The main objective of this study is to assess the asymmetric impact of the CMA on Namibia's MDF. The specific objectives of the study are two-fold as follows:

- To determine whether the CMA has an asymmetric impact on the stability of the Namibian MDF; and
- To assess the stability of the Namibian MDF in the presence of the CMA proxy.

1.4 Hypothesis

H_{01}: The CMA does not have an asymmetric impact on the Namibian MDF in both the short- and long-run.

H_{A1}: The CMA has an asymmetric impact on the Namibian MDF in both the short- and long-run.

H_{02}: Namibia's MDF is not stable.

H_{A2}: Namibia's MDF is stable.

1.5 Justification of the Study

The literature has long recognised the nonlinearity among macroeconomic variables and processes. As Keynes (1936, p. 314) remarked, “the substitution of a downward for an upward tendency often takes place suddenly and violently, whereas there is, as a rule, no such sharp turning point when an upward is substituted for a downward tendency.” Most studies in Namibia (from Ikhide & Katjomuise (1999) to Mbazima-Lando & Manuel (2020)) assumed a linear relationship between money demand and its determinants. These studies do not recognise that negative and positive values of regressors may not have the same impact on money demand. Moreover, although Manuel et al. (2020) explored the nonlinear relationship between money demand and its determinants, they failed to test for stability, hence this study intends to fill the gap by testing stability in a nonlinear money demand model. Of equal importance, the study fills the gap relating to the question of the asymmetric impact of the CMA on the stability of Namibia’s MDF. The study will further enrich the literature on the subject matter to the benefit of policymakers, enabling them to predict the impact of monetary policy on the general economy with greater confidence.

Although the study could be viewed to be of greater relevance to policymakers such as the BoN, it does not shy away from the academic arena in its compelling contribution to the existing literature on the nonlinear autoregressive distributed lag model. It highlights a detailed step-wise guide on the estimation of the model, while providing evidence on issues related to the CMA, all of which may be useful to academics.

1.6 Outline of the Study

The study proceeds by providing a review of existing theoretical and empirical literature in the second chapter. The third chapter provides a detailed explanation of the methodology of the study, encompassing data and variables, model specification and various diagnostic tests. Chapter four presents and discusses the results of the model developed in chapter three, while chapter five provides the conclusion and policy implications.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

When economists talk about the word *supply*, *demand* always follows, and the analysis of money is no exception. Money supply or money demand are vital building blocks in understanding how monetary policy affects the economy because they suggest the factors that influence the quantity of money in an economy. This chapter discusses some of the prominent theories as well as various empirical studies on money demand in the literature.

2.2 Theoretical Literature Review

From the classical period to the present, economists have done considerable work on the topic of money demand. Substantial work focuses on ascertaining the determinants of money demand, its functional form, and the most suitable way for estimating this function. Two sets of variables said to influence the demand for money stand out. The first set refers to scale variables, particularly income and/or wealth. The second set relates to opportunity cost variables, mainly comprising interest rates, inflation, and the exchange rate. This section, therefore, presents a review of the relevant theories of money demand.

2.2.1 Quantity Theory of Money (QTM)

Developed in the 19^{th} and early 20^{th} centuries, the QTM is a classical theory of money demand linking the quantity of money to aggregate output. The clearest explanation of the theory is drawn from the work of Irvin Fisher, in his influential book 'The Purchasing Power of Money' published in 1911. In his analysis, Fisher examines the link between the quantity of money and the total money spent on final goods and services. This is done through the concept of velocity of money, which is simply the average number of times in a year that currency is spent on final goods and services. This relationship is mathematically expressed as follows:

$$M \times V = P \times Y \qquad (2.1)$$

Where:

M is the stock of money,

V is the velocity of money (or simply velocity),

P is the price level and

Y is the aggregate real output or income of the economy.

Equation 2.1 is called the Equation of Exchange which is nothing more than an identity – a relationship true by definition. The Equation of Exchange states that the supply of money multiplied by the average number of times currency is used in transactions over a year must equal the current value of all final goods and services produced.

Fisher opines that velocity is determined by both the institutional and technological features of the economy that affect the way individuals undertake transactions. Essentially, he assumes that velocity is constant in the short-run and that the said features would affect velocity somewhat slowly over time. The view that velocity is constant in the short-run transforms the Equation of Exchange into the quantity theory of money. This theory postulates that nominal income is exclusively determined by movements in the quantity of money. Accordingly, when the money supply doubles, so that $M \times V$ doubles, the value of nominal aggregate output must also double.

Classical economists, including Fisher (1911), regard aggregate output as reasonably constant in the short-run because wages and prices are thought to be completely flexible.

The flexibility in wages and prices would imply that during normal times, the aggregate output would remain at full employment. In their perspective, therefore, the QTM explains the movements in the price level. The evidence that the QTM is, in fact, a theory of money is shown by dividing both sides of equation 2.1 by V as follows:

$$M = \frac{1}{v}PY \qquad (2.1.1)$$

Assuming that the money market is in equilibrium, where the quantity of money M that people choose to hold, equals the quantity demanded M^D and representing $\frac{1}{v}$ as k, the above equation can be restated as:

$$M^d = kPY \qquad (2.1.2)$$

Given that k is constant, equation 2.1.2 says that the level of transactions generated by a fixed level of nominal income determines the quantity of money demanded by people. In this perspective, Fisher assumes that the demand for money is purely a function of income and that interest rates have no effect on the quantity of money demand. Consequently, Fisher concludes that people hold money exclusively to conduct transactions and that they lack the freedom of action pertaining to the amount they intend to hold.

In terms of the stability of money demand, the classical theory suggests that the demand for money is stable. Classical economists opine that money is held to carry out transactions, or as a medium of exchange. Hence, money is narrowly defined as the sum of notes and coins, as well as demand deposits. The QTM assumes that money supply is exogenous, and the income velocity of money is stable. The stability in the velocity implies that demand for money is also stable thus a tight link between the amount of money and nominal income exists.

2.2.2 Keynes' Liquidity Preference Theory

In his 1936 book 'The General Theory of Employment, Interest and Money' John Maynard Keynes deviates from the classical view that velocity is constant and states that interest rates are important to money demand. Keynes' liquidity theory of money postulates three motives for holding money:

- Transactions: Economic agents hold money to carry out current transactions. Like classical economists, Keynes views the transactions demand for money to be proportional to income.
- Precautionary: This component of the money demand recognises that people demand money as a cushion against unforeseen circumstances or to take advantage of opportune purchases. This is also believed to be in proportion to income.
- Speculative: Perhaps his most fundamental contribution to the theory of money demand, Keynes takes the view that economic agents demand money as a store of wealth. Based on this view, he assumes that people could store their wealth in two forms of assets, namely *money* which earns a zero rate of return, and *bonds* earning a non-zero rate of return. A higher rate of return on bonds increases the opportunity cost of holding money, hence, individuals tend to hold more bonds in their portfolios. Conversely, when interest rates are low, so is the opportunity cost of holding money. Keynes, therefore, concludes that money demand and interest rates are inversely related.

Keynes also argues that due to the speculative motive, the demand for real balances would at some point become absolute or otherwise, infinitely elastic, which he refers to as the liquidity trap. The liquidity trap occurs at the level of interest rate at which the bond market participants prefer holding money to bonds so that they would be willing to sell and not buy bonds at existing prices. Brycz (2012) defined the concept as a condition where an increase in money supply by the central bank has no effect on either prices or output. Nonetheless, Keynes notes that while the liquidity trap is an intellectual curiosity for monetary economists, it does not have any practical relevance, thus he did not construct his macroeconomic model on the assumption of the liquidity trap (Handa, 2009).

In his analysis, Keynes carefully distinguishes real and nominal quantities of money, stressing that money should be valued in terms of what it can buy. As such, people want to hold a certain amount of real money balances ($\frac{M^d}{P}$) which he specifies to be a function of real income (Y) and real interest rate (i):

$$\frac{M^d}{P} = f(\underset{-}{i}, \underset{+}{Y}) \tag{2.2}$$

Equation 2.2 states that a higher rate of interest leads individuals to reduce their real money balances, while a higher income induces an increase in their real balances as shown by the minus and positive signs under i and Y, respectively. Regarding the stability of money demand, Keynes' analysis of the speculative demand for money made it a function of subjective expectations, which can be quite volatile, in turn, resulting in high volatility in the money demand function.

2.2.3 Friedman's Modern Quantity Theory of Money

In 1956, Milton Friedman restated the classical quantity theory of money in his article 'The Quantity Theory of Money: A Restatement'. As his predecessors, Friedman pursues the question of why people choose to hold money. His approach to the demand for money treats money as one of the asset classes in which agents keep a portion of their wealth. Businesses view money as a capital good in the production of other goods or services while individuals hold money, particularly for the services it provides, which is the general purchasing power of money. Friedman, therefore, applies the theory of asset demand to money.

In his analysis, Friedman reveals that factors that influence the demand for any other asset should also affect the demand for money. Like Keynes, Friedman acknowledges that people want a given amount of real money balances. Thus, the demand for money is a function of a wealth variable and the expected returns on other assets relative to the expected return on money. He expresses his money demand function as follows:

$$\frac{M^d}{P} = f(\underset{+}{Y}, \underset{-}{r_b - r_m}, \underset{-}{r_e - r_m}, \underset{-}{\pi^e - r_m}) \tag{2.3}$$

In the above equation, the positive (+) and negative (-) signs on the right-hand side of the equation indicate the relationship between money demand and the terms just above the signs. The equation indicates that real demand for money ($\frac{M^d}{P}$) positively depends on income (Y). Additionally, money demand is negatively influenced by the differences between expected returns on bonds (r_b), equity (r_e), and goods (π^e) relative to the expected return on money (r_m) (Mishkin, 2011).

Unlike the usual concept of income, Friedman's money demand function uses permanent income, the expected average long-run income of an individual. He reasons that short-run fluctuations in permanent income are much smaller compared to those in current income since many such movements are transitory. Accordingly, a rise in permanent income will induce individuals to demand more real money balances. One important implication of the use of permanent income in this analysis is that the demand for money does not fluctuate significantly with transitory short-run fluctuations in income.

Friedman's analysis of the demand for money reveals three forms in which individuals can hold their wealth besides money, including bonds, equity, and goods. The choice to hold wealth in any of these forms is influenced by their expected returns relative to the return on money. Bonds are long-term securities that yield a stream of fixed nominal income, usually the coupon rate of interest. The yield on equities is determined by the dividend rate, expected capital gains/losses, and changes in the price level. Goods on the other hand do not yield a stream of income in monetary terms but rather in kind. Friedman however considers an explicit yield of goods in the form of the expected rate of change in the price per unit of time.

A rise in the expected return on bonds and equity relative to the expected return on money, which leads to an increase in the opportunity cost of holding money, reduces the quantity of real money demanded by agents. An increase in the expected return from holding goods relative to the return on money induces an increase in the quantity of nominal money balances held by individuals.

On the stability of the money demand function, Friedman asserts that the function is stable, although not constant. Contrary to Keynes, he believes that random fluctuations in money demand are small and that they can be predicted with greater accuracy using the money demand function. Moreover, his analysis suggests that money demand is insensitive to interest rates, which renders high predictability in the velocity of money, contributing to the stability of the money demand function.

2.2.4 Baumol-Tobin Demand for Money Model

Following World War II, economists began to expound the Keynesian approach to money demand by further developing more precise theories to explain Keynes' designated motives for holding money. Accordingly, William Baumol and James Tobin independently developed similar theories of the transactions demand for money in 1952 and 1956, respectively, called the Baumol-Tobin demand for money. Their contributions show that the transactions demand for money does not only depend on income but also the level of interest rate on bonds. Moreover, they reveal that there are economies of scale in holding money.

In developing their transaction demand for money models, Baumol and Tobin take into consideration a hypothetical individual who receives a once-off payment in one period and spends it over the course of that period. Their theory takes the form of inventory analysis, considering two assets, namely money and bonds whose main discriminatory feature is that money serves as a medium of exchange whereas bonds do not, hence all payments are made in money. The analysis further assumes there is no uncertainty so that the yield on bonds is known with certainty. Because of this assumption, bonds are equivalent to interest-paying savings deposits or other short-term financial assets.

The analysis assumes the individual keeps an optimum amount of money for transaction purposes. Holding inventories of money attracts an opportunity cost in the form of interest income foregone in case the individual chooses to hold some of his wealth in bonds. Essentially, as interest rates rise, the opportunity cost of holding money increases, leading to a fall in the demand for money. Moreover, if the interest on bonds is greater than the own cost of holding money, the individual will increase his holding of bonds compared to money. Suppose the transaction cost of holding money exceeds the interest payment, the individual is better off holding more money. Unlike Keynes, who associates the transactions demand for money solely with income, Baumol and Tobin emphasise that the transactions demand for money is not independent of interest rates (Harerimana & Kumar, 2021). Tobin's transactions demand theory postulates that the income elasticity of money is 0.5 and velocity is not constant, hence money demand is not stable (Harerimana & Kumar, 2021).

2.3 Empirical Literature Review

2.3.1 Studies out of Africa

There is voluminous empirical work on the stability of the money demand function globally, with stability largely observed in the developed world, while divergent results have been found in developing countries (Hasanov et al., 2022). Ho and Saadaoui (2021) explored the determinants of money demand in Vietnam by utilising both linear and nonlinear ARDL models over the period spanning from 2000q3 to 2018q1. Their findings suggest that a nominal appreciation of the Vietnamese Dong against the US Dollar in the long-run increases demand for money in both the linear and nonlinear specifications, indicative of the dominance of the substitution effect over the wealth effect. Nonetheless, their results suggest that the wealth effect dominated the substitution effect in the short-run as a nominal depreciation of the local currency increases demand for money in both specifications. The coefficients of the linear and nonlinear specifications are found to be stable over the sample period.

In Malaysia, Leong et al. (2019) also assessed the asymmetric effects of the exchange rate on the demand for Divisia money in Malaysia using quarterly data ranging from 1991q1 to 2018q4. The results establish a long-run relationship among the variables employed through the Bounds test. Their findings further suggest that asymmetric effects exist in the short term and are transmitted in the long-run. However, long-term asymmetric effects are found to be incomplete as they held only for currency appreciation, implying the presence of a substitution effect. Finally, the CUSUM and CUSUMSQ tests offered evidence of the stability of their model.

Mahmood and Alkhateeb (2018) investigated the asymmetrical effects of the real exchange rate on the money demand in Saudi Arabia using annual time series data for the period 1968–2016 by employing the nonlinear ARDL approach. Consistent with theoretical prepositions, their results suggest that income and inflation have positive and negative impacts on money demand in that country, respectively. Moreover, a real appreciation of the US Dollar is found to have a positive effect on money demand, while a real depreciation is found to have a higher and negative effect. The model is found to be stable through the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests.

In Nepal, Bhatta (2013) analysed the stability of the country's money demand function using annual time series data for the period 1975–2009, employing a linear ARDL approach. Using the Bounds test procedure, their findings confirm a long-run cointegration relationship between real money demand, GDP and interest rates, and establish a stable and predictable demand for narrow money in Nepal using the CUSUM and CUSUMSQ tests. Moreover, they suggest that money is a luxury asset in that country given a greater-than-unitary income elasticity for money.

2.3.2 Studies in Africa

In Rwanda, Harerimana and Kumar (2021) assess money demand stability and its implications for the conduct and implementation of monetary policy using quarterly time series data (2004q1–2014q4). The Johansen cointegration approach and Error Correction Method (ECM) approaches are employed and the results show cointegration between variables. The study further reveals that their chosen version of Rwanda’s money demand function is stable over the study period through the CUMSUM and CUSUMSQ tests.

Employing the NARDL method, Elhassan (2021) investigated the asymmetric impact of fluctuations in the exchange rate on money demand in Sudan using annual data from 1960 to 2018. Their empirical results reveal that the exchange rate has an asymmetric impact on money demand in both the long and short term. The depreciation and appreciation of the Sudanese Pound are found to increase demand for money in the long-run, with a depreciation having the dominant effect. In the short-run, however, only the positive change in the exchange rate is found to have a significant impact on money demand.

Bah et al. (2019) investigated the relationship between the exchange rate and demand for money in Gambia for the period 2001q2 to 2017q4. They use both linear and nonlinear ARDL models and the results show that the demand for money is cointegrated with its determinants, while the CUSUM and CUSUMSQ tests indicate that their model is stable.

In Lesotho, Damane et al. (2018) employed the linear ARDL bounds testing and ECM approaches to cointegration to test the stability of demand for real money balances (M2) from 1980–2015. The findings of the study revealed strong evidence of a stable long-run relationship between M2, real GDP, the consumer price index, real interest rate spread, and the real exchange rate from the CUSUM and CUSUMSQ tests.

In a study for Ghana, Nchor and Adamec (2016) examined the demand for broad money and its stability using an ECM, covering the period from 1990–2014. With cointegration determined through the Johansen's cointegration approach, the results reveal that income affects the demand for money in the long-run, whereas the interest rate influences money demand in the short-run. Additionally, using the CUSUM test, demand for money is found to be stable while the Chow test indicates that there are no structural breaks over the study period. Using a similar estimation technique, Jiranyakul and Opiela (2014) examined the short- and long-term stability properties of Thailand’s money demand function from 1993q1 to 2012q4. The results indicate that among the monetary aggregates of M1, M2, and M3, cointegration only exists in M1. Further, the results found short-run instability of M1 money demand through the dynamic OLS estimation technique.

Doguwa et al. (2014) investigated structural breaks, cointegration, and demand for money in Nigeria from 1991q1 to 2013q4. The study employs various econometrics techniques including the Gregory-Hansen test for structural breaks, the ECM for short-run dynamics as well as the CUSUM and CUSUMSQ tests for stability. A long-run relationship is established, although with a break in the first quarter of 2007, while the demand for money function is found to be stable over the study period.

A study by Mwoya and Dimoso (2014) assessed the long- and short-run relationship between real money demand (M1, M2, and M3) and real income, inflation rate, real interest rate, and real exchange rate in Tanzania for the period 2001q1 to 2010q4 using a linear ARDL model. The study establishes a long-run relationship and the CUSUM and CUSUMSQ tests reveal a stable money demand function for Tanzania. The results further suggest that real income positively influences real money demand both in the long and short-run. The impact of inflation and the real exchange rate is found to be positive in the long-run but negative in the short-run for M1 and M2. Nonetheless, the influence of real income and inflation on the broader money supply, M3, is found to be positive, both in the long and short-run.

Kapingura (2014) examined the stability of the money demand function in South Africa using quarterly time series data for the period 1994–2012. The study uses the Johansen cointegration test and Vector Error Correction Model (VECM) to analyse long-run and short-run interactions between the model variables. The results reveal a long-run relationship between money demand and its determinants, while the error correction term indicates that 51% of disequilibrium is corrected within a quarter. Furthermore, the study concludes that the country's money demand function was unstable from 2003–2007 through the CUSUM and CUSUMSQ tests.

Mhamdi (2013) assessed the stability of the money demand function in Tunisia between 1986–2007 employing two Chow tests (CUSUMSQ and the Chow's forecast test). The study reveals instability in the money demand for Tunisia through the Chow test.

2.3.3 Studies in Namibia

Notwithstanding the voluminous literature on money demand globally, there has been limited work undertaken on the subject with varying results in Namibia. Mbazima-Lando and Manuel (2020) studied the impact of financial innovation on the demand for money and its implication for monetary policy in Namibia, using quarterly time series data from 2002q1 to 2019q2 by employing the Engle-Granger cointegration method. Demand for money is found to be mainly symmetrically determined by prices and interest rates. The results further reveal that Namibia's money demand function, with and without financial innovation, is unstable using the CUSUM and CUSUMSQ tests.

In another study, Manuel et al. (2020) used the Nonlinear Autoregressive Distributed Lag Model (NARDL) framework to investigate the asymmetric determinants of money demand in Namibia using quarterly data between 2000q1 to 2020q2. The results reveal an asymmetric long-run relationship between money demand and its explanatory variables. The findings further indicate that money demand in Namibia responds negatively to both increases and decreases in prices and real interest rates. They further find that money demand rises due to increases and decreases in real income. The appreciation and depreciation of the Namibia Dollar exchange rate are also found to increase money demand over their study period, echoing the findings by Mahmood and Alkhateeb (2018).

Sheefeni (2013) also studied the demand for money in Namibia using a linear Autoregressive Distributed Lag Model (ARDL) approach for the period 2000q1 to 2012q4. The results reveal that there is no long-run equilibrium between money aggregates (M1 and M2) and their determinants namely real output, inflation, and interest rate. The absence of a long-run cointegrating relationship between variables means that the study could not test for stability in the money demand function.

2.1 Chapter Conclusion

Chapter two presents a review of the theoretical framework and empirical literature on money demand. Generally, the empirical review shows that key determinants of money demand are income and opportunity cost variables, such as interest rates and inflation. These findings are supported by the reviewed theoretical prepositions of money demand. Moreover, money demand is said to be stable across most of the reviewed studies from different jurisdictions. It is also evident in the reviewed empirical literature that most works assume a linear relationship between money demand and its determinants. Studies that have explored the nonlinear relationship have been limited to discovering the nonlinearity between the exchange rate and money demand, all of which have been conducted outside Namibia. For Namibia, the nonlinear relationship has been thinly investigated with only one study exploring the asymmetric determinants of money demand. This study did not only fail to ascertain the instability or stability of the Namibian MDF, but it also did not consider the possibility of an asymmetric impact of the CMA on the country's MDF.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

To assess the asymmetric implications of the CMA on the stability of the Namibian MDF, various econometric techniques are employed in this study. This chapter briefly discusses time series properties of the data and variables in the system, model specification, as well as model diagnostic tests.

3.2 Data and Data Sources

The study uses quarterly secondary time series data between 2001q1 and 2021q3 sourced from BoN and Namibia Statistics Agency (NSA). The choice of the study period is informed by the availability of quarterly data on all relevant variables. In terms of the estimation technique, the data behaviour is analysed using the 10^{th} version of the EViews software.

3.3 Measurements of Variables

To facilitate the nonlinear analysis of the Namibian MDF, the study uses broad money stock, a proxy for money demand as the dependent variable. This is regressed on SA's repo rate capturing the CMA monetary policy impact, one scale variable, three opportunity cost variables, while the deposit rate variable is included as an own return on holding money balances (Table 3.1). These variables are measured as follows:

Table 3.1: Variables, Definition and Data Sources

Variable Notation	Variable Description	Source	Expected Sign
	Dependent Variable		
M2	Broad money supply (N$ million)	BoN	N/A
	Independent Variables		
SA_REPO	SA repo rate (percent)	SARB	Negative
RGDP	Real gross domestic product (N$ million)	NSA	Positive
TB3	Three-month treasury bills rate (percent)	BoN	Negative
INF	Inflation (annual percentage change)	NSA	Negative
NADUSD	Namibia/USD bilateral exchange rate (index)	BoN	Positive or Negative
DR	Weighted average deposit rate ((percent)	BoN	Positive

Source: Author's construct.

3.3.1 Money Demand

Concerning the measurement of money demand, the study uses broad money supply ($lnMD_t$) backed by the works of Irvin Fisher in 1911, in his QTM, and several empirical studies including those of Mbazima-Lando and Manuel (2020), Manuel et al. (2020) as well as Shidhika (2015). M2 comprises narrow money supply (which is the sum of domestic currency in circulation outside depository corporations and transferable deposits) and time deposits of the money-holding sectors with the depository corporations (Bank of Namibia, 2021).

3.3.2 CMA

Relating to the impact of the CMA on the Namibian MDF, the study employs the SARB's repo rate (SA_repo_t), a short-term policy rate used to affect the cost of borrowing in the financial sector, which in turn, affects the broader economy. This consideration follows the nature of the monetary union where monetary and exchange rate policies of the LNE countries are harmonised with those of SA. In particular, the LNE countries have pegged their respective national currencies to the ZAR, thereby losing monetary autonomy. The precinct has been that as long as the LNE countries defend their currency pegs to the ZAR with SA pursuing a stable inflation policy, the impact of that policy is transmitted to the LNE countries without delay. This, in turn, leads to economic growth in the LNE countries (Ikhide & Uanguta, 2010). The CMA arrangement, therefore, resembles an asymmetric monetary union in which SA is responsible for monetary policy formulation and implementation, adds Seleteng (2016). Moreover, it has been empirically determined that interest rates and prices in the LNE countries respond instantaneously to changes in the SA repo rate (Ikhide & Uanguta, 2010; Seleteng, 2016).

3.3.3 Scale Variable

In the money demand function, a scale variable serves as a measure of transactions relating to economic activity. In the literature, current income, permanent income, or wealth have been widely used. The study utilises Real Gross Domestic Product ($RGDP_t$) as a proxy for current income, chiefly due to the availability of data. The adoption of current income as the representative scale variable is further informed by the theories developed by Classical and Keynesian economists. Moreover, RGDP is expected to have a positive influence on the level of money demanded.

3.3.4 Opportunity Cost Variables

3.3.4.1 Inflation

Concerning the measurement of inflation, the study uses the annual percentage change (year-on-year) in the Namibian consumer price index (INF_t) as shown in Table 3.1. Since Namibia’s headline inflation data is available monthly, the quarterly series is generated by taking the arithmetic average of the respective annual percentage change for each month in each quarter. The adoption of headline inflation instead of other measures of inflation is explained by two considerations. The first is data availability. Indeed, the monthly data on the consumer price index is available for longer periods. The second consideration is that it represents the most widely used measure as an indicator of inflation in empirical studies and analyses of monetary policy (Mahmood & Alkhateeb, 2018; Sheefeni, 2013; Mabuku, 2009). Inflation is expected to have a negative impact on money demand.

3.3.4.2 Interest Rate

The study employs the three-month treasury bills effective yield ($TB3_t$), an opportunity cost for holding money balances, as used by Manuel et al. (2020). The deposit rate (DR_t) is utilised as an "own return" on money balances following Ho and Saadaoui (2021). Unlike (Mbazima-Lando & Manuel, 2020) who utilised the six-month deposit rate, this study uses the average weighted deposit rate, which relates to the rate commercial banks declare on transferable and time deposits (Bank of Namibia, 2021). As far as the influence of interest rate is concerned, theory suggests that an increase in the treasury bill rate would reduce the attractiveness of money balances, hence a negative relationship is expected. The deposit rate is the "own return" on money balances (except for the tiny part of M2 that is held as notes and coins, on which no interest is received by the holders). A higher deposit rate makes holding money balances more attractive; hence a positive relationship is expected.

3.3.4.3 Exchange Rate

The exchange rate employed in this study is the bilateral exchange rate between the Namibia Dollar and the US Dollar ($NADUSD_t$) as utilised by Leong et al. (2019) and Mabuku (2009). Given the openness of most economies, money demand functions have increasingly captured the effects of external monetary and financial factors by means of movements in foreign interest and exchange rates (Farazmand & Moradi, 2015). The effect of the exchange rate on money demand may be positive or negative depending on two effects: wealth and substitution. If people perceive a depreciation of the local currency as an increase in their wealth since their foreign assets are worth more, then they may raise their demand for the domestic currency, resulting in a wealth effect (Yesigat et al., 2018). On the other hand, following a depreciation of the local currency, individuals may expect further depreciation, thereby reducing their demand for the domestic currency that is, the income effect (Mahmood & Alkhateeb, 2018).

3.4 Model Specification

A standard money demand function is specified by including a scale and the opportunity cost of holding money variables, Leong et al. (2019). The present study adapted a nonlinear ARDL model by Mahmood and Alkhateeb (2018) specified in Equation 3.1. The NARDL estimation technique distinguishes between the effects of positive and negative changes in the regressors on the dependent variable by decomposing partial sums of the variables and using such partial sums as regressors. Unlike linear models, the NARDL has some notable advantages. Firstly, the order of integration is not a problem unless there are variables that are integrated of a higher order such as $I(2)$ and above. Secondly, it is not data-hungry and can be applied to smaller samples. Thirdly, the ability to simultaneously estimate both long- and short-run asymmetries in a simple and tractable manner provides a straightforward way for testing long- and short-run symmetry restrictions.

$$lnMD_t = f(lnGDP_t, lnCPI_t, lnRER_t) \tag{3.1}$$

Where: $lnMD_t$ designates the natural logarithm of money supply, while $lnGDP_t$, $lnCPI_t$ and $lnRER_t$ are natural logarithms of real income, inflation, and real exchange rate between the United States Dollar and Saudi Arabian Riyals, respectively. To study the asymmetric relationship between money demand and its determinants in Namibia, Equation 3.1 is modified to suit the study's main thrust.

To capture the impact of the CMA on the Namibian MDF, the study employs the SA_repo supported by Ikhide and Uanguta (2010) who stressed that this policy rate was the only relevant policy instrument in the CMA, which argument was later corroborated by Seleteng (2016). Other modifications to Equation 3.1 include the consideration of variables such as the TB3 in line with Manuel et al. (2020), and the DR as used by Harerimana and Kumar (2021). The bilateral NAD/USD exchange rate is applied instead of the real effective exchange rate used by Mahmood and Alkhateeb (2018) due to data availability.

Another modification applied to the original model involves decomposing all explanatory variables into asymmetric effects, that is, the partial sums of positive and negative changes in the regressors using the approach by Shin et al. (2014). The partial sums are constructed and defined as follows:

$$SA\_repo_t^+ = \sum_{t=1}^{t} \Delta SA\_repo_i^+ = \sum_{t=1}^{t} max(\Delta SA\_repo_i, 0)$$

$$SA\_repo_t^- = \sum_{t=1}^{t} \Delta SA\_repo_i^- = \sum_{t=1}^{t} min(\Delta SA\_repo_i, 0)$$

$$lnRGDP_t^+ = \sum_{t=1}^{t} \Delta lnRGDP_i^+ = \sum_{t=1}^{t} max(\Delta lnRGDP_i, 0)$$

$$lnRGDP_t^- = \sum_{t=1}^{t} \Delta lnRGDP_i^- = \sum_{t=1}^{t} min(\Delta lnRGDP_i, 0)$$

$$TB3_t^+ = \sum_{t=1}^{t} \Delta TB3_i^+ = \sum_{t=1}^{t} max(\Delta TB3_i, 0)$$

$$TB3_t^- = \sum_{t=1}^{t} \Delta TB3_i^- = \sum_{t=1}^{t} min(\Delta TB3_i, 0)$$

$$INF_t^+ = \sum_{t=1}^{t} \Delta INF_i^+ = \sum_{t=1}^{t} max(\Delta INF_i, 0)$$

$$INF_t^- = \sum_{t=1}^{t} \Delta INF_i^- = \sum_{t=1}^{t} min(\Delta INF_i, 0)$$

$$NADUSD_t^+ = \sum_{t=1}^{t} \Delta NADUSD_i^+ = \sum_{t=1}^{t} max(\Delta NADUSD_i, 0)$$

$$NADUSD_t^- = \sum_{t=1}^{t} \Delta NADUSD_i^- = \sum_{t=1}^{t} min(\Delta NADUSD_i, 0)$$

$$DR_t^+ = \sum_{t=1}^{t} \Delta DR_i^+ = \sum_{t=1}^{t} max(\Delta DR_i, 0)$$

$$DR_t^- = \sum_{t=1}^{t} \Delta DR_i^- = \sum_{t=1}^{t} min(\Delta DR_i, 0) \quad (3.2)$$

The modified long-run form of Equation 3.1 is given as Equation 3.3 below:

$$lnMD_t = \delta_0 + \delta_1 lnMD_{t-i} + \delta_2^+ SA\_repo_{t-i}^+ + \delta_2^- SA\_repo_{t-i}^- + \delta_3^+ lnGDP_{t-i}^+ + + \delta_3^- lnGDP_{t-1}^- + \delta_4^+ TB3_{t-i}^+ + \delta_4^- TB3_{t-i}^- + \delta_5^+ INF_{t-i}^+ + \delta_5^- INF_{t-i}^- + \delta_6^+ NADUSD_{t-i}^+ + \delta_6^- NADUSD_{t-1}^- + \delta_7^+ DR_{t-1}^+ + \delta_7^- DR_{t-1}^- + e_t) \quad (3.3)$$

Where the superscripts represent partial sums of positive and negative changes in the regressors. The $\sum_{i=0}^{7} \delta$ are the long-run parameters for estimation. In line with the study's main objective, Equation 3.2 is finally transformed fully into a NARDL model, capturing both short- and long-run dynamics taking the form:

$$\Delta lnMD_t = \beta_0 + \sum_{i=1}^{p} (\beta_{1,i} \Delta lnMD_{t-i}) + \sum_{j=0}^{q_2^+} (\beta_{2,i}^+ \Delta SA\_repo_i^+) + \sum_{j=0}^{q_2^-} (\beta_{2,j}^- \Delta SA\_repo_i^-) + \sum_{k=0}^{q_3^+} (\beta_{3,i}^+ \Delta lnRGDP_i^+) + \sum_{k=0}^{q_3^-} (\beta_{3,j}^- \Delta lnRGDP_i^-) + \sum_{l=0}^{q_4^+} (\beta_{4,i}^+ \Delta TB3_i^+) + \sum_{l=0}^{q_4^-} (\beta_{4,j}^- \Delta TB3_i^-) + \sum_{m=0}^{q_5^+} (\beta_{5,i}^+ \Delta INF_i^+) + \sum_{m=0}^{q_5^-} (\beta_{5,j}^- \Delta INF_i^-) + \sum_{l=0}^{q_6^+} (\beta_{6,i}^+ \Delta NADUSD_i^+) + \sum_{l=0}^{q_6^-} (\beta_{6,j}^- \Delta NADUSD_i^-) + \sum_{n=0}^{p_7^+} (\beta_{7,i}^+ \Delta DR_i^+) + \sum_{n=0}^{p_7^-} (\beta_{7,j}^- \Delta DR_i^-) + \delta_1 lnMD_{t-i} + \delta_2^+ SA\_repo_{t-i}^+ + \delta_2^- SA\_repo + \delta_3^+ lnRGDP_{t-i}^+ + \delta_3^- lnRGDP_{t-1}^- + \delta_4^+ TB3_{t-i}^+ + \delta_4^- TB3_{t-i}^- + \delta_5^+ INF_{t-i}^+ + \delta_5^- INF_{t-i}^- + \delta_6^+ NADUSD_{t-i}^+ + \delta_6^- NADUSD_{t-1}^- + \delta_7^+ DR_{t-1}^+ + \delta_7^- DR_{t-1}^- + e_t) \quad (3.4)$$

Equation 3.4 displays the ultimate asymmetric specification of the NARDL money demand model for Namibia, in which the coefficients β and δ capture the respective short-run and long-run coefficients. The long-run effects of positive and negative shocks in the explanatory variables on the demand for money are measured by $-\left(\frac{\sum_{i=2}^{+} \delta_i^+}{\delta_1}\right)$ and $-\left(\frac{\sum_{i=2}^{-} \delta_i^-}{\delta_1}\right)$, respectively. Additionally, $\sum_{i=1}^{p_j} p$ and $\sum_{i=1}^{q_j} q$ represent the lag orders.

3.5 Diagnostic Checks

3.5.1 Unit Root

In econometric analyses, particularly when studying patterns in different time series, the concept of stationarity is very important. A series is said to be stationary if its mean and variance are constant while its autocovariance (at various lags) remains constant, no matter the point they're measured at. A stationary time series, therefore, allows one to study its behaviour in one period and generalises such behaviour to other periods. An econometric model with nonstationary variables may produce spurious regression results. Results from a spurious regression may result in false conclusions, in turn, leading to wrong policy formulations. Nonetheless, differencing a nonstationary series once (or a few times) may address the problem of non-stationarity. A nonstationary series is said to be integrated of order one $I(1)$, if it becomes stationary after differencing it once (Gujarati, 2003).

Two main methods for testing the stationarity of a variable exist. The first involves graphing the data to observe any obvious trends. A noticeable upward or downward trend in the data may be an indication of non-stationarity. The second and formal method employs various unit root tests and/or stationarity tests. One prominent test among the unit root tests, and one which this study considers, is the Augmented Dickey-Fuller (ADF) test.

The ADF test is an extension of the Dickey-Fuller (DF) test conducted by testing the hypothesis that a series has a unit root. The regression analysis under this test is conducted according to three different forms specified below:

$$\Delta Y_t = \delta Y_{t-1} + \mu_t \tag{3.5}$$

$$\Delta Y = \beta_1 + \delta Y_{t-1} + \mu_t \tag{3.6}$$

$$\Delta Y = \beta_1 + \beta_2 t + \delta Y_{t-1} + \mu_t \tag{3.7}$$

Equation 3.5 is a random walk process, Equation 3.6 is a random walk with drift, while Equation 3.7 is a random walk with drift around a stochastic trend. The main drawback of the standard DF test is that it is based on a process integrated of order one and it also assumes that the error terms are uncorrelated. The ADF test corrects this shortcoming by taking into account any autocorrelation that may be present in Equation 3.7 by introducing lagged values of the dependent variable in the regression as shown below:

$$\Delta Y = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{t=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \tag{3.7.1}$$

In Equation 3.7.1, ε_t designates a pure white noise error term with mean equal to zero and a constant variance δ^2. In the ADF test, economists test the null hypothesis that the coefficient $\delta = 0$, that is, the variable has a unit root – the series is nonstationary. The alternative hypothesis is that the coefficient $\delta \neq 0$ which implies that the series is stationary. The null hypothesis is rejected when the ADF test statistic is greater than the critical test value at a selected level of significance. Failure to reject the null hypothesis implies that classical regression techniques, such as ordinary least squares, will not provide unbiased and consistent coefficient estimates (Wooldridge, 2003).

To validate the results from the ADF test, the study conducts the Phillips-Perron (PP) unit root test. The ADF test has been found to have low power to reject the null hypothesis in cases of near-unit root as well as trend stationary processes (Korap, 2010). It is for this reason that the PP unit root test is conducted, to affirm the ADF test results, as it corrects any possible autocorrelation and heteroscedasticity that may be present in the residuals. The PP test undertaken in the study takes two forms provided in the equations below:

$$\Delta y = \alpha + \psi Y_{t-1} + \mu_t \quad (3.8)$$

$$\Delta y = \alpha + \lambda t + \psi Y_{t-1} + \mu_t \quad (3.9)$$

Equations 3.8 and 3.9 are random walk with drift and random walk with drift around a stochastic trend, respectively. Like the ADF test, the hypotheses are given as follows:

H_0: The series has a unit root.

H_1: The series has no unit root.

The null hypothesis of a unit root is rejected if the test statistic from the PP test is above the critical value at a 5% significance level. This would imply that the series is stationary. Alternatively, a probability value above 5% from the PP test is an indication that one does not have enough evidence to reject the null hypothesis of unit root, otherwise, the series in question is stationary.

3.5.2 Cointegration

In 1987, Engle and Granger gave a formal treatment to the notion of cointegration. Cointegration makes regression analysis involving $I(1)$ variable potentially meaningful. Theoretically, cointegration is the notion that a linear combination of two series, each of which is integrated of order one, is integrated of order zero (Wooldridge, 2003). More explicitly stated, it refers to a long-run relationship between two variables that are linked to form an equilibrium relationship when the individual variables themselves are non-stationary in their levels but become stationary when differenced. Hence, individual variables may be unstable and diverging from one another in the short-run but converge toward equilibrium over the long-run.

To test for the existence of cointegration, the study employs the bounds testing procedure by Pesaran and Shin (1999) and later advanced by Pesaran et al. (2001). The approach offers notable advantages over the alternatives such as the Johansen approach. Firstly, the procedure can be applied whether the underlying explanatory variables are integrated of order zero $I(0)$, order one $I(1)$, or a mixture of both. Secondly, the bounds test also allows for possible different optimal lag lengths of the underlying variables. Thirdly, the procedure is not data-hungry, hence it can provide robust results even in cases of smaller sample sizes (Damane, 2020). Finally, as opposed to other methods, the bounds test has finite-sample critical values, which means that the distribution of the test statistics is known. The test is performed on the level, the log transformation, or both forms of the variables but not on their first difference. The hypotheses are as follows:

H_0: No cointegrating equation.

H_1: There is a cointegrating equation.

If the computed F statistic is greater than the upper bound value, the null hypothesis of no cointegrating equation is rejected and it is concluded that the variables are cointegrated. Conversely, the null hypothesis is not rejected if the calculated F statistic is less than the lower bound. The test is inconclusive where the F statistic lies between the upper and lower bonds.

3.5.3 Lag Structure

To determine the optimum lag structure, the study considers various criteria including the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Criterion (HQC), Final Prediction Error (FPE), and the Bayesian Information Criterion (BIC). The lag length selected is based on the length selected by most of the criteria.

3.5.4 Test for Long- and Short-run Asymmetry

To test for the existence of long-run and short-run asymmetric relationships among the proposed variables under the NARDL framework, the study employs the Wald test, introduced by Shin et al. (2014). The long-run asymmetries are defined by equating the long-run coefficients of positive and negative changes of a variable in question, that is, $\delta_i^+ = \delta_i^-$. For the short-run asymmetries, all coefficients (current and/or differenced) of the positive partial sums are equated to all the coefficients (current and/or differenced) of the negative partial sums of a given explanatory variable, that is, $\sum_{i=2}^{n} \beta_i^+ = \sum_{i=2}^{n} \beta_i^+$. The hypotheses are as follows:

H_0: The coefficients are symmetric.

H_1: The coefficients are asymmetric.

The null hypothesis implies that the relationship between variables is symmetrical, whereas the alternative means that their relationship is asymmetrical. The NARDL estimation technique employs the F statistic and critical values in order to make conclusions on the above hypotheses. Rejecting the null hypothesis means the relationship between money demand and its explanatory variables is asymmetrical.

3.5.5 Normality Test

The test for normality determines whether the model residuals are normally distributed or not. Because inferences hinge on critical and probability values drawn from t and F statistics that are normally distributed, it is important for the errors to follow a normal distribution (Wooldridge, 2003). The test is carried out using the Jarque-Bera (1987) test. This test follows a chi-square distribution with two degrees of freedom. The hypotheses are specified as follows:

H_0: Residuals are normally distributed.

H_1: Residuals are not normally distributed.

The null hypothesis is rejected if the probability in the test is less than 5%. This is indicative that the residuals do not follow a normal distribution.

3.5.6 Heteroscedasticity Test

The test ascertains whether the variance of each error term, conditional on chosen values of the regressors, is constant over time. Heteroscedasticity implies that confidence intervals will be unnecessarily larger which results in invalid or inconsistent t and F statistics. This study employs the Breusch-Pagan-Godfrey (1979) test. The hypotheses are:

H_0: Homoscedastic residuals.

H_1: Heteroscedastic residuals.

The null hypothesis is rejected when the probability from the test is less than 5%, implying that the variance is not constant.

3.5.7 Test for Serial Correlation

This test seeks to determine whether the residuals in time series data are uncorrelated over time. To determine whether the residual in the current period depends on the residual in the previous period, the study employs the Breusch-Godfrey (1978) Lagrange Multiplier test with the following hypotheses:

H_0: No serial correlation.

H_1: There is serial correlation.

A probability value of less than 5% provides enough evidence to reject the null hypothesis.

3.5.8 Test for Misspecification of the Model

This test helps to ascertain whether the model is correctly specified or not. The study uses Ramsey's RESET[2] test developed by Ramsey (1969). The decision rule is that if the probability of the F statistic is found to be above 5%, one fails to reject the null hypothesis of correct specification. If the probability value is, however, found to be less than 5%, then one has enough evidence to conclude that the model suffers from misspecification errors. The hypotheses are as follows:

H_0: Model correctly specified.

H_1: Model is misspecified.

3.5.9 Test for Stability in Namibia's Money Demand Function

This study is centred around the stability of the money demand function for Namibia, hence the importance of testing for stability. The study uses the CUSUM tests and CUSUMSQ (Galpin & Hawkins, 1984). The CUSUM test does not only determine

[2] Regression Specification Error Test

whether the coefficients of the money demand function are changing systematically but also reveals structural changes. The CUSUMSQ test examines the presence of abrupt change with the null hypothesis that the parameters are stable (Tule, 2020). The decision about the parameter stability is determined by the position of the CUSUM and CUSUMSQ lines. Evidence of the structural instability of the specified model is found when the CUSUM and CUSUMSQ lines cross the 5% significance level, hence one may reject the null hypothesis of stability.

3.5.10 Dynamic Multipliers

When the null hypothesis of symmetry is rejected in section 3.5.4, the study derives the dynamic multipliers of the positive and negative changes in the SA_repo on LNCM2. The asymmetric dynamic multipliers are obtained to assess the traverse between the short-run and the long-run, in line with the preposition by Shin et al. (2014). Although the dynamic multipliers are obtained for all explanatory variables, the study only reports those relating to the SA_repo. Cumulatively, they are evaluated as follows:

$$m_h^+ = \sum_{j=0}^{h} \frac{\gamma LNCM2_{t+j}}{\gamma SA\_repo_t^+} \qquad m_h^- = \sum_{j=0}^{h} \frac{\gamma LNCM2_{t+j}}{\gamma SA\_repo_t^-} \tag{3.8}$$

Equation 3.8 entails that by construction, as $h \to \infty$, $m_h^+ \to \delta_2^+$ in Equation 3.4, that is the asymmetric long-run coefficient for the CMA variable on money demand. Similarly, as $h \to \infty$, $m_h^- \to \delta_2^-$. The asymmetric dynamic multipliers capture the effects of shocks in the SA_repo on money demand in Namibia from an initial equilibrium to a new one.

3.6 Chapter Conclusion

Chapter three discusses econometric techniques employed in assessing the asymmetric implications of the CMA for Namibia's MDF. Particularly, the chapter looks at the definitions and time series properties of the variables in the study, the development of the appropriate model, and various diagnostic tests of the model.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the empirical model developed in the preceding chapter. It proceeds by discussing the results of the time series properties of the variables used in modelling the demand for money in sections 4.2 to 4.5. The analysis of the cointegration of the variable is presented in section 4.6, while the results of the NARDL model and the various diagnostic tests thereon are provided in further sections of the chapter.

4.2 Descriptive Statistics

The summary statistics of the variables of interest in the Namibian money demand function over the period 2001q1 to 2021q3 are presented in Table 4.1.

Table 4.1: Descriptive Statistics

	LNCM2	SA_REPO	LNRGDP	TB3	INF	NADUSD	DR
Mean	10.8578	7.3855	10.2561	7.7706	5.8203	10.0791	5.7804
Median	10.8698	7.0000	10.2897	7.7900	5.4639	8.9477	5.7192
Maximum	11.7548	13.5000	10.5296	13.0300	14.2262	17.9506	9.4467
Minimum	9.7653	3.5000	9.7519	3.9100	1.3612	5.9987	2.8838
Std. Dev.	0.5964	2.5168	0.2224	2.0205	2.6547	3.2299	1.5533
Skewness	-0.2602	0.8100	-0.5007	0.5573	0.7937	0.5555	0.3821
Kurtosis	1.9006	2.9688	2.0652	3.1297	3.3250	1.9891	2.5453
Jarque-Bera	5.1167	9.0793	6.4895	4.3550	9.0799	7.8032	2.7349
Probability	0.0774	0.0107	0.0390	0.1133	0.0107	0.0202	0.2548
Sum	901.1931	613.0000	851.2567	644.9600	483.0844	836.5672	479.7772
Sum Sq. Dev.	29.1682	519.4127	4.0571	334.7613	577.9105	855.4661	197.8448
Observations	83	83	83	83	83	83	83

Source: Author’s construct.

The results in Table 4.1 show that money supply (LNCM2) has the largest mean, while the variable representing the exchange rate (NADUSD) carries the widest standard deviation. The standard deviation ranges from 0.2224 to 3.2299. While most variables tend to be positively skewed, the money supply and the SA repo rate (SA_REPO) exhibit negative skewness. Based on the kurtosis measure of normality, it is evident that the distributions of most series are leptokurtic, with normality found in the SA repo rate for which the kurtosis value is approximately three, as well as the three-month TB rate (TB3) and inflation (INF) variables for which the kurtosis values are above three. Finally, using the probabilities of the Jarque-Bera test for normality, the null hypothesis of normal distribution is not rejected at 5% significance level for LNCM2, TB3, and DR. The rest of the variables are, however, not normally distributed as per the Jarque-Bera test results.

4.3 Correlation

Table 4.2 exhibits the correlation coefficients of the system variables. The correlation matrix indicates the direction and degree of relationship among the variables considered in modelling the Namibian MDF over the study period.

Table 4.2: Correlation Matrix

Variable	LNCM2	SA_REPO	LNRGDP	TB3	INF	NADUSD	DR
LNCM2	1						
SA_REPO	-0.7216*	1					
LNRGDP	0.9414*	-0.6939*	1				
TB3	-0.6174*	0.9424*	-0.5936*	1			
INF	-0.4557*	0.7268*	-0.4367*	0.6978*	1		
NADUSD	0.7620*	-0.3798*	0.6465*	-0.2370	-0.2233	1	
DR	-0.6509*	0.9304*	-0.6351*	0.9399*	0.5691*	-0.3791*	1

Source: Author’s construct.

Note: The asterisks (*) indicate significance.

Overall, the correlation coefficients between the dependent variable with the regressors corroborate theoretical propositions. LNCM2 is positively and statistically significantly correlated with RGDP. The high correlation coefficient of 0.9414 typically implies that when RGDP rises, the demand for money also increases. Likewise, the coefficient of the exchange rate variable is positive and statistically significant. On the other hand, the correlation between LNCM2 and the variables representing the SA repo rate, deposit rate as well as the three-month TB rate, is observed to be negative and statistically significant.

4.4 Unit Root

Determining the stationarity of the variables of interest is one of the primary tasks in econometric work, as noted by Yesigat et al. (2018). Although the NARDL approach does not stringently require pre-testing for unit root, the study applies the ADF unit root test to ascertain whether any of the variables contain a unit root and the order of integration. These results are corroborated by the PP unit root test, primarily due to the weaknesses of the ADF test. The test results are presented in levels, and at first difference, with both tests carried at intercept as well as trend and intercept.

Table 4.3: Unit Root Tests - ADF and PP

Variable	ADF Test		PP Test	
	Level	1st diff	Level	1st diff
LNCM2	-1.6174	-12.2962***	-2.1914	-12.7388***
	(-1.2265)	(-12.4765)***	(-1.6883)	(-13.2007)***
SA_repo	-2.2272	-4.8257***	-1.8967	-4.8349***
	(-3.5310)	(-4.7915)***	(-2.6004)	(-4.7984)***
RGDP	-2.3487	-4.8299***	-1.8814	-15.1130***
	(1.1041)	(-12.0471)***	(-3.0118)	(-20.5937)***
TB3	-2.2151	-5.7964***	-1.7112	-5.8351***
	(-2.9450)	(-5.7571)***	(-2.3254)	(-5.7961)***
INF	-3.4847**	-5.7480***	-2.8516	-5.7551***
	(-3.9265)	(-5.7136)***	(-3.0368)	(-5.7227)***
NADUSD	-0.7066	-6.4560***	-0.8387	-7.2369***
	(-2.4127)	(-6.4720)***	(-2.1147)	(-7.1396)***
DR	-2.2398	-4.4118***	-1.4249	-4.2938***
	(-3.3599)	(-4.4040)***	(-2.2718)	(-4.2768)***

Source: Author's construct.

Note 1: The test statistics without brackets indicate that the equation includes an intercept only, while those inside the parenthesis suggest that the test was carried out with an intercept and a trend.

Note 2: The asterisks (*** and **) indicate significance at 1% and 5% levels, respectively.

Table 4.3 shows that all variables, except for INF are not stationary in levels, but they become stationary at first difference at 1% significance level. It is thus concluded that most variables are integrated of order one [$I(1)$], with INF being the only variable integrated of order zero [$I(0)$].

To validate the results of the ADF test, the study further conducts the PP unit root test. Although commonly used, the ADF test has been found to have low power to reject the null hypothesis in cases of near unit root as well as trend stationary processes Korap (2010); Gujarati (2003). The PP unit root test is thus conducted to affirm the results obtained from the ADF test and to correct any possible autocorrelation that may be present in the residuals.

The PP test corroborates the results obtained in the ADF test, however, unlike in the ADF test, INF is found to be nonstationary in levels, hence it is $I(1)$. It is evident from

Table 4.3 that none of the variables of interest are integrated of higher order, that is, all variables are at most $I(1)$. Given that none of the variables is found to be integrated of higher order, that is $I(2)$ or above, the study proceeds to undertake the NARDL bounds test for cointegration.

4.5 Lag Length Selection Criteria

Prior to conducting the bounds test for cointegration, it is vital to determine the optimal lag length to be included in the model, especially in cointegration analysis, according to Yesigat et al. (2018). Very often in time series data, the lags of the dependent and independent variables influence the dependent variable since the latter rarely responds to the former instantaneously. Moreover, the addition of lags removes the autocorrelation that may be present in the residuals of cointegrated variables.

Table 4.4: Optimal Lag Length Criteria Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-535.1159	NA	0.0022	13.7245	13.9344	13.8086
1	39.4330	1032.7330	3.61e-09	0.4194	2.0990*	1.0923
2	124.6196	138.0239	1.48e-09	-0.4967	2.6526	0.7650*
3	178.1920	77.3070	1.42e-09	-0.6125	4.0065	1.2380
4	252.1677	93.6401*	8.74e-10*	-1.2445*	4.8438	1.1945

Source: Author’s construct.
Note: the asterisks (*) denote the lag order selected by the criterion.

The optimal lag length ensures that the model retains the right degrees of freedom and is free from multicollinearity, serial correlation in the residuals, and misspecification errors (Gujarati, 2003). As denoted by the asterisks in Table 4.4, the lag length chosen by most criteria is four. Nonetheless, the author retains the ability of data mining to arrive at an accurately specified model.

4.6 Bounds Test for Cointegration

Section 4.4 confirms that all variables in the system are not integrated of order two or higher, while the subsequent section determines the optimal lag length. Against this background, the next stage involves testing for the existence of a long-run relationship among variables using the bounds testing approach presented in Table 4.5.

Table 4.5: Results of the Bounds Test for Cointegration

Test Statistic	Value	Significance Level	Lower bound	Upper bound
F statistic	9.3557	10 percent	1.76	2.77
K	12	5 percent	1.98	3.28
		1 percent	2.41	3.61

Source: Author’s construct.

The computed *F* statistic of 9.3557 obtained from the bounds test as depicted in Table 4.5 is above the upper bound critical value of 2.77 at all levels of significance. This indicates the presence of a long-run nonlinear equilibrium relationship among the variables in the study, consistent with the results obtained by Manuel et al. (2020). In light of this empirical evidence, the long- and short-run dynamics of the model are estimated and presented in the following sections.

4.7 NARDL Long- and Short-run Model Estimation Results and Discussion

Given the establishment of a nonlinear cointegration relationship among the variables of interest, the study estimates the long- and short-run NARDL coefficients. In this regard, the NARDL model estimated took the form NARDL (3, 3, 3, 1, 1, 2, 2, 0, 2, 2, 0, 2, 2), with the respective long- and short-run results presented in panel A and B of Table 4.6.

Table 4.6: Asymmetric Long-run and Short-run Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Panel A: Long-run Results of NARDL (Dependent Variable LNCM2)				
SA_REPO_POS	-0.5246**	0.2447	-2.1440	0.0377
SA_REPO_NEG	-0.0938	0.0994	-0.9435	0.3507
LNRGDP_POS	3.4775**	1.4345	2.4242	0.0196
LNRGDP_NEG	5.1567**	2.3704	2.1754	0.0351
TB3_POS	-0.1110	0.1300	-0.9227	0.3613
TB3_NEG	-0.2851**	0.1088	-2.6212	0.0121
INF_POS	0.0405	0.0358	1.1301	0.2647
INF_NEG	0.1596**	0.0735	2.1707	0.0350
NADUSD_POS	0.0784**	0.0351	2.2363	0.0306
NADUSD_NEG	0.1391**	0.0571	2.4349	0.0191
DR_POS	1.0288**	0.4554	2.2592	0.0290
DR_NEG	0.1216	0.0972	1.2517	0.2174
C	10.2985**	0.2873	35.8504	0.0000
Panel B: Short-run Results of NARDL (Dependent Variable LNCM2)				
D(SA_REPO_POS)	-0.0156	0.0101	-1.5485	0.1288
D(SA_REPO_POS(-1))	0.1024***	0.0134	7.6206	0.0000
D(SA_REPO_POS(-2))	0.0718***	0.0139	5.1810	0.0000
D(SA_REPO_NEG)	-0.0119	0.0085	-1.3930	0.1708
D(SA_REPO_NEG(-1))	0.0009	0.0144	0.0620	0.9508
D(SA_REPO_NEG(-2))	0.0264***	0.0097	2.7223	0.0093
D(LNRGDP_POS)	0.3357***	0.0707	4.7457	0.0000
D(LNRGDP_NEG)	0.4961***	0.1024	4.8427	0.0000
D(TB3_POS)	0.0443***	0.0111	3.9774	0.0003
D(TB3_POS(-1))	0.0315**	0.0123	2.5666	0.0138
D(TB3_NEG)	-0.0781***	0.0107	-7.2942	0.0000
D(TB3_NEG(-1))	-0.0308***	0.0105	-2.9270	0.0055
D(INF_NEG)	0.0155***	0.0043	3.6267	0.0008
D(INF_NEG(-1))	-0.0195***	0.0042	-4.6504	0.0000
D(NADUSD_POS)	0.0025	0.0057	0.4363	0.6648
D(NADUSD_POS(-1))	-0.013445***	0.0051	-2.6320	0.0117
D(DR_POS)	0.0091	0.0228	0.3972	0.6932
D(DR_POS(-1))	-0.2148***	0.0252	-8.5140	0.0000
D(DR_NEG)	0.0658***	0.0215	3.0539	0.0039
D(DR_NEG(-1))	0.0481**	0.0207	2.3237	0.0249
ECT	-0.2297***	0.0176	-13.0606	0.0000
Panel C: Wald Test Results – Asymmetry Test				
	Long-run		**Short-run**	
Variable	**F-Statistics**	**Probability**	**F-Statistics**	**Probability**
SA_REPO	13.2081***	0.0007	7.3766***	0.0095
LNRGDP	6.0702**	0.0178	0.6669	0.4186
TB3	1.1522	0.2891	22.4662***	0.0000
INF	12.2956***	0.0011	11.6385***	0.0014
NADUSD	1.7527	0.1925	N/A	N/A
DR	24.4478***	0.0000	19.19013***	0.0001

Source: Author’s construct.

Notes: The asterisks (*** and **) indicate significance at 1% and 5% levels, respectively. N/A indicates that the test was not undertaken as the model chose positive shocks only.

Panel A of Table 4.6 presents the empirical long-run NARDL model estimation results. In the long-run, the asymmetric impact of most variables on money demand is incomplete. Accordingly, only a positive shock to the South African monetary policy rate (SA_repo) has a statistically significant impact on money demand in Namibia. A percentage increase in the SA repo rate reduces the demand for money by 0.52%. This result corroborates the findings of Ikhide and Uanguta (2010) and Gumata et al. (2013) who established that a contractionary monetary policy innovation which constitute a rise in the SA repo rate sharply increased Namibian lending rates and reduced the level of money supply. Assuming equilibrium in the money market, it can be argued that a rise in interest rates and/or a decrease in money supply will in turn lead to a reduction in the demand for money. The finding, however, contradicts Seoela (2022) who indicated an insignificant response of money supply to a shock in the SA repo rate for Namibia and Eswatini. Moreover, the null hypothesis of symmetry from the Wald test is rejected at a 1% significance level, hence it is concluded that SA_repo has an asymmetric influence on the demand for money in Namibia, as displayed in Table 4.6, panel C.

Concentrating on the effects of the SA_repo on the Namibian demand for money in the short-run, panel B in Table 4.6 shows that half of the lags are significant. Positive shocks in the variable increase demand for money at the first and second lags, while negative shocks have a significant decreasing influence at lag two. Like in the long-run, the null hypothesis of symmetry is rejected in the short-run, which offers proof of the short-run asymmetric influence of the CMA on Namibia's MDF.

For the income variable, the long-run income elasticity relating to positive (LNRGDP_POS) shocks is found to be greater than unity and statistically significant at

5% level. According to panel A of Table 4.6, a positive shock in income raises money demand by 3.48% in the long-run. This result suggests that the transactions motive is at play in Namibia. This in part means that expansions in income in the long-run induce people to demand more money, but also suggests that a broad monetary aggregate such as M2 may be a luxury good in Namibia, consistent with theoretical prepositions and priori expectations. Regarding the sign and magnitude of the coefficient, the finding is in line with past findings by Mahmood and Alkhateeb (2018); Elhassan (2021), Leong et al. (2019), Simawu et al. (2014), Nakamya (2014) and Bhatta, 2013. Given the underdeveloped bonds and stock markets in Namibia, it is not surprising for the elasticities of positive and negative shocks in income to be greater than unity, as savings increases are mostly held in savings deposits.

In Table 4.6, panel A, the response of money demand to negative shocks in RGDP is found to be statistically significant with a coefficient above unity. This finding contradicts the findings by Manuel et al. (2020). Accordingly, a 1% decline in real income leads economic agents to reduce their Namibian Dollar holdings by 1.2%. The finding, however, corroborates monetary theory and the a priori expectations. The long-run coefficients of real income are found to be asymmetric using the Wald test as shown in panel C.

From Table 4.6, panel B, the coefficients of positive and negative shocks in the real income variable behave in a similar fashion to their long-run counterparts with varying magnitudes. The demand for money increases and decreases with positive and negative shocks in real income, respectively, in line with monetary theory. Moreover, short-run coefficients of both positive and negative shocks in income are observed to be less than unity in the short-run, corroborating money demand theory. Contrary to the long-run, the null hypothesis of symmetry from the Wald test cannot be rejected in the short-run, suggesting that short-run coefficients of positive partial sums and negative partial sums of income are symmetric. Nonetheless, the symmetric nature of positive and negative short-run effects is short-lived and tends to be corrected in the long-run.

The coefficient of the positive shocks in the three-month TB rate (TB3_POS) variable is found to carry the expected sign although it is not statistically significant. This may suggest that agents are insensitive to increases in the three-month treasury bill rate, attributable to an underdeveloped domestic capital market. The results are similar to the findings by Tiwari (2017) who suggested that short-term interest rates were not significant regressors for broad money supply. In Indonesia, Prasetyo (2018) also found that agents were insensitive to interest rates due to high competition between commercial banks, in turn making the opportunity cost of holding money relatively constant.

Negative shocks in the interest rate however have a statistically significant influence on the demand for money by economic agents in Namibia. Holding all else constant, a percentage reduction in the interest rate leads to people increasing their demand for the Namibia Dollar by 0.29%. This finding is not only theoretically consistent with the opportunity cost of holding money but also in line with a priori expectations. The negative sign on TB3_NEG indicates that the opportunity cost of holding money decreases with negative shocks in the TB3_NEG, which finding confirms those by Mbazima-Lando and Manuel (2020), Mabuku (2009) and Ho and Saadaoui 2021. Notwithstanding, the null hypothesis for long-run symmetry of the Wald test is not rejected, hence there is not enough evidence to conclude otherwise over the analysis period.

Table 4.6, panel B shows that in the short-run the current and first lag of positive shocks in the three-month TB rate positively influence money demand, and that they are statistically significant unlike in the long-run. For negative shocks, both the current and first lag coefficients tend to increase demand for money as shown by the significant negative coefficients in panel B. The sets of coefficients are found to be asymmetric through the Wald test.

For the inflation variable, Table 4.6, panel A indicates that its asymmetric impact on money demand in Namibia is incomplete. Specifically, only the negative shock in inflation (INF_NEG) has a statistically significant influence on the demand for money over the long-run in Namibia. A percentage negative shock in inflation causes a reduction of 0.16% in the demand for money by economic agents. This result supports the finding by Manuel et al. (2020) although in contradiction to a priori expectation. Despite the correct sign, positive shocks in the inflation rate do not have a statistically significant influence on the demand for money in Namibia. This result could be due to the relatively low and stable inflation rates recorded in Namibia over the study period. Moreover, the study finds that the long-run coefficients of positive and negative shocks in inflation are asymmetric through the Wald test.

As for the short-run results, panel B depicts that only the negative current and one lag partial sum of the inflation variable are chosen by the model, and they tend to change signs from positive at current level to negative at first lag. A 1% negative shock in the inflation variable will decrease demand for money by 0.02% in the short term, augmenting the long-run result. INF_NEG lagged once, however, suggests that a 1% negative shock would increase demand for money by 0.02%. This finding is in conformity with theory as agents are expected to switch to money balances from real assets as inflation slows down.

The coefficients for the exchange rate (NADUSD) variable are positive and statistically significant at 5% significance level, despite the absence of long-run asymmetry. The exchange rate is simply the price of foreign currency expressed in terms of the local currency (Mabuku, 2009). According to Table 4.6, panel A, a depreciation of the Namibia Dollar against the US Dollar increases demand for money by 0.08% in the long-run. A trend analysis of Namibia's trade balance indicates that the country has consistently recorded a trade deficit over the study period. It, therefore, follows that a rise in the local currency units required to realise foreign transactions consequently raises the demand for the domestic currency. This finding supports those of past studies by Al Rasasi (2020), Mahmood and Alkhateeb (2018) as well as Mabuku (2009).

An appreciation of the domestic currency reduces money demand by a higher magnitude of 0.14% over the long term, relative to a depreciation, confirming the existence of the wealth effect and supporting the finding by Yesigat et al. (2018). When the value of the local currency appreciates, agents require fewer local currency units to afford the same quantity of foreign goods, hence a reduction in their demand for the Namibia Dollar. The appreciation of the local currency may be construed as a reduction in the value of an individual's wealth abroad, thereby reducing their demand for money in Namibia. The positive coefficient on NADUSD_NEG concurs with the findings of Bahmani-Oskooee and Bahmani (2015). They noted that Iranians held less of their own currency following an appreciation due to expectations of further depreciation of the US

Dollar. The results suggest that NADUSD_POS and NADUSD_NEG long-run coefficients are statistically not different from each other through the Wald test.

Table 4.7, panel B further shows that only the positive partial sums of the exchange rate are chosen by the model with differing signs. Nonetheless, only the first lag with a decreasing impact on money demand is found to be significant in the short-run. The negative coefficient of NADUSD_POS(-1) is in line with the finding by Leong et al. (2019). The finding confirms the presence of a substitution effect. It means that following a depreciation of the local currency, people may expect the domestic currency to fall further, and thus choose to hold foreign currency to hedge against further losses.

In terms of the deposit rate (DR), panel A of Table 4.6 indicates that only the positive increase in the rate leads to a statistically significant impact on money demand in Namibia, although the coefficients of both positive and negative changes in the rate are found to be asymmetric. A positive shock in the deposit rate of 1% raises money demanded by 1.03% in the long-run. This may suggest that in the long-run, agents respond to higher DR by increasing their demand for money, in line with the finding by Hasanov et al. (2017) and Al Rasasi (2020). They noted that the relationship between interest rates on money and money demand depends on the measures of both the interest rate and the monetary aggregate considered. A positive relationship between the deposit rate and money supply is expected because higher deposit rates induce increases in demand deposits. This finding further supports those by Harerimana and Kumar (2021) who also suggested that the demand for money in Rwanda was an increasing function of the deposit rate. Moreover, the null hypothesis of the Wald test for symmetry is rejected at 1% significance level, suggesting an asymmetric long-run relationship between DR and broad money supply, LNCM2.

Panel B in Table 4.7 shows that in the short-run, three out of the four coefficients of the deposit rate have a significant influence on the demand for money in Namibia. The first lag of a positive shock in the deposit carries a highly significant negative coefficient, supporting the findings by Mbazima-Lando and Manuel (2020), but not in line with a priori expectation. The coefficient of negative shocks in the deposit rate at current and at first lag are found to be positive and significant at 1% and 5% levels. This finding implies that in the short-run, falling interest income on deposits results in reduced demand for money, corroborating the long-run results. Evidence of short-run asymmetry is found for the deposit rate as is the case in the long-run through the Wald test.

The short-run relationship of the MDF explained is corroborated by a theoretically coherent error correction term (ECT). The ECT represents the speed of adjustment to long-run equilibrium following disequilibria in the previous period. Table 4.7, panel C shows that the estimated coefficient of the ECM is negative and statistically significant at 1%. This suggests that 23% of short-run deviations in money supply from its long-run equilibrium are corrected in the next period. The magnitude of the ECT coefficient does not significantly differ from those reported by Mbazima-Lando and Manuel (2020) as well as Mabuku (2009) whose ECTs ranged from 8% to 28%.

4.8 NARDL Model Diagnostics

To assess the verifiability of the empirical analysis presented above, the statistical properties of the model are examined. In this regard, certain residual diagnostic checks are carried out including normality, heteroscedasticity, serial autocorrelation, and misspecification.

Table 4.8: NARDL Model Diagnostic Tests

Test	Test Statistic	Probability Value
Normality (Jarque Berra)	1.1189	0.5715
Heteroscedasticity (Breusch-Pagan-Godfrey)	0.5340	0.9706
Serial Correlation (Breusch-Godfrey LM Test)	2.3720	0.0847
Ramsey RESET Test	0.3916	0.5349

Source: Author's construct.

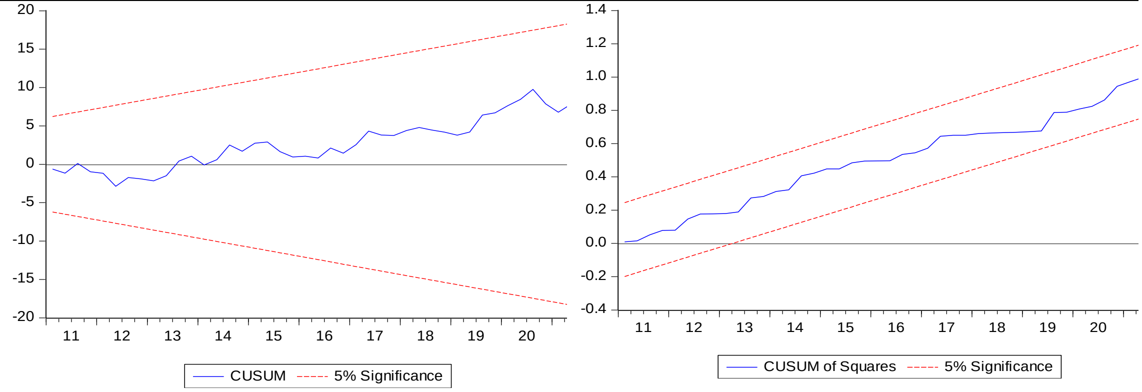
Table 4.8 indicates that the model passes all the residual diagnostic tests as the probability values of all the test statistics are above 5%. This, in turn, is suggesting that there is not enough evidence to reject the respective null hypotheses of the test statistics. It is thus concluded that the model residuals are normally distributed, homoscedastic, serially uncorrelated, and that the model is correctly specified.

4.9 NARDL Model Stability

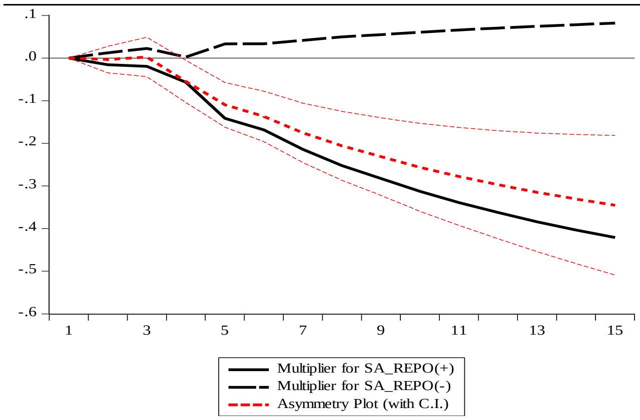
One of the objectives of this study is to test the stability of the Namibian MDF. It is well documented in the literature that a stable money demand function is a prerequisite for effective and successful monetary policy implementation (Harerimana & Kumar, 2021; Mahmood & Alkhateeb, 2018; Yesigat et al., 2018). The results of the CUSUM and CUSUMSQ tests are in Figure 4.1, panel A. Moreover, the asymmetric dynamic multiplier effects of the SA_repo on money demand, which shows the traverse to a new equilibrium is given in panel B.

Figure 4.1: NARDL Stability Test and Dynamic Multiplier Results

Panel A: CUSUM and CUSUMSQ Test



Panel B: Asymmetric Cumulative Dynamic Multiplier Effects of the SA_repo on LNCM2



Source: Author's construct.

Figure 4.1, Panel A, shows that both CUSUM and CUSUMSQ plots lie well within the 5% critical bounds, implying long-run and short-run parameter stability as well as the absence of structural breaks. A stable nonlinear money demand function can therefore be claimed over the sample period. These results corroborate those by Shidhika (2015) and Mabuku (2009), but they contradict a more recent study by Mbazima-Lando and Manuel (2020). This is a significant contribution to the literature in terms of stability in the Namibian MDF, bridging the gap in the nonlinear ARDL study by Manuel et al. (2020), which failed to test for stability.

Panel B of Figure 4.1 reveals the pattern of the dynamic multipliers of a shock in the SA_repo on the demand for money in Namibia. The effect of a positive shock dominates the adjustment from an initial equilibrium to a new equilibrium in the demand for money over the horizon. It is also noted that the effect of shocks in the SA_repo is more pronounced in the long-run, relative to the short-run.

4.10 Chapter Conclusion

Chapter Four presents and dissects the results of the NARDL model developed in Chapter Three. The results indicate that a significant asymmetric long-run relationship exists between money demand and its determinants, including the South African repo rate, income, three-month TB rate, inflation rate, exchange rate, and the deposit rate. It is further established that the demand for money in Namibia is stable over the sample period, while the dynamic multiplier effect of a positive shock in the CMA variable dominates the effect of a negative shock with a more pronounced impact in the long-run.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter Five's main contribution is to the conclusions and policy implications suggested in line with the findings of the study. It proceeds with a summary of the results in section 5.2, followed by the conclusions and policy implications in sections 5.3 and 5.4, respectively. Section 5.4 then highlights areas for further related research.

5.2 Summary of the Study

This study investigates the asymmetric impact of the CMA on the stability of the Namibian MDF and tests the stability of the country's MDF over the period 2001q1 and 2021q3. In view of money demand (proxied on broad money supply), SA repo rate, real income, three-month treasury bill rate, inflation, bilateral exchange rate, and the deposit rate variables, the study employs a NARDL methodology to account for the asymmetries in the relationship between the variables.

The empirical analysis provides evidence of the presence of a long-run nonlinear cointegrating relationship between money demand and its regressors. The results indicate that the asymmetric impact of most variables on money demand in Namibia is incomplete. In the long-run, positive shocks in the SA repo rate are found to significantly influence money demand, while their negative counterparts are insignificant. This finding partly corroborates those of Ikhide and Uanguta (2010), Gumata et al. (2013), and Seleteng (2016) who highlighted the importance of SA's repo rate as the appropriate policy rate in the CMA. The results further reveal evidence that the CMA has long- and short-run asymmetric influence on Namibia's money demand function.

The findings of the study further indicate that income elasticities of both positive and negative shocks are greater than unity and statistically significant in the long-run. This may suggest that the transactions demand for money is at play in Namibia, while indicating that broad money supply could be regarded as a luxury good. In the short-run, however, the coefficients of the real GDP variable are observed to be less than unity, in line with monetary theory. Through the Wald test, the study fails to reject the null hypothesis of symmetry in the long-run for the real income variable, while there is not enough evidence to state the same in the short-run period.

For the opportunity cost variables, the study finds a significant long-run relationship between the negative shocks in the three-month treasury bill rate and money demand while positive shocks are found to be insignificant. The former corroborates monetary theory and empirical studies. By implication, falling interest rates reduce the opportunity cost of holding money, thereby inducing a shift from treasury bills to money. In the short-run, both positive and negative shocks in the variable are found to have a significant positive influence on money demand in Namibia, explained by the underdevelopment in Namibia's capital markets. The asymmetry in the influence of the three-month treasury bills rate on money demand is observed in the short-run only.

The asymmetric impact of inflation on money demand is observed to be incomplete in both the long and short-run. The study results indicate that only negative shocks in inflation significantly influence (that is, a decreasing impact) money demand, corroborating the findings of Manuel et al. (2020). The finding may be attributed to the relatively low rates of inflation over the study period. The study further finds evidence of asymmetric long-run coefficients of the positive and negative shocks in inflation on money demand.

For the exchange rate variable, the study reveals evidence of the significant influence of both depreciation and appreciation of the Namibian Dollar against the US Dollar in the long-run. A depreciation of the local currency against the US Dollar increases demand for money, explained by the need to realise foreign transactions. The appreciation on the other hand confirms the dominance of the wealth effect over the substitution effect in the long-run. In the short-run, the results show that the substitution effect supersedes the wealth effect as a depreciation of the domestic currency reduces demand for money with a lag.

The asymmetric long-run impact of the deposit rate is found to be incomplete with only the positive shocks exerting a significant influence on money demand. The finding augments those by Hasanov et al. (2017) and Al Rasasi (2020). Moreover, short-run shocks seem to affect demand for money in a similar fashion, whereby a positive shock lagged once – as well as negative shocks at current and first lag – reduce money demand. Although the impact of the lagged positive shock is not in line with a priori expectation, the short-run impact of negative shocks is somewhat in line with the findings obtained over the long-run.

Finally, the study results find a negative and statistically significant ECT at 1%, suggesting that 23% of short-run deviations in the money supply from its long-run equilibrium are corrected in the next quarter. To assess the verifiability of the empirical analysis, the study examines the residuals of the model for normality, heteroscedasticity, serial autocorrelation, and misspecification. The results indicate that the model passes all diagnostic tests carried out, and it is found to be stable through the CUSUM and CUSUMSQ tests.

5.3 Conclusion

The main objective of the study was to investigate the asymmetric impact of the CMA on the Namibian MDF. Mindful of the main objective, the study specifically aimed to determine whether the CMA has an asymmetric impact on the stability of the Namibian MDF as well as to assess the function's stability or instability. The study rejects the null hypothesis that the CMA does not have an asymmetric impact on the Namibian MDF in both the short and long runs. Moreover, it is concluded that Namibia's MDF is stable over the sample period, with the effects of positive shocks in the SA_repo on money demand found to be dominant and more pronounced in the long-run, relative to negative shocks.

5.4 Policy Recommendations and/or Implications

The findings of the study have significant implications for dynamic monetary policy in Namibia. First, the study reveals evidence of the asymmetric influence of the regressors on the demand for money in Namibia. It follows that linear estimations of the Namibian MDF may be profoundly misleading when the underlying relationship is asymmetric. Based on evidence that demand for money in Namibia responds differently to positive and negative shocks in the CMA proxy, it is recommended that in its implementation of monetary policy, the BoN must continue observing developments in the SA_repo, particularly upward adjustments given their significant impact on Namibia's MDF. This could be implemented by considering positive shocks in the SA repo rate as a crucial input when determining the country's monetary policy stances on top of maintaining factors such as the currency peg, inflation and foreign exchange reserves. Since Namibia's monetary policy is largely reactive to monetary developments in the SA, mainly to maintain the currency peg, the recommendation informs and aligns the attention of the BoN's MPC members.

Secondly, the study reveals that Namibians are insensitive to positive shocks in the three-month TBs, contradicting economic theory. It is recommended that the Namibian authorities expedite their efforts to develop the domestic capital markets. Specifically, efforts towards the implementation of the central securities depository, aimed at enabling electronic trading of securities, including those by the Namibian government and other issuers.

5.5 Suggestions for Further Research

This study focuses on the assessment of the CMA on the stability of the Namibian MDF, as such researchers are invited to conduct panel analyses on the implication of the CMA on the LNE countries using the NARDL methodology. This may result in more robust results compared to the time series analysis employed in the present study.

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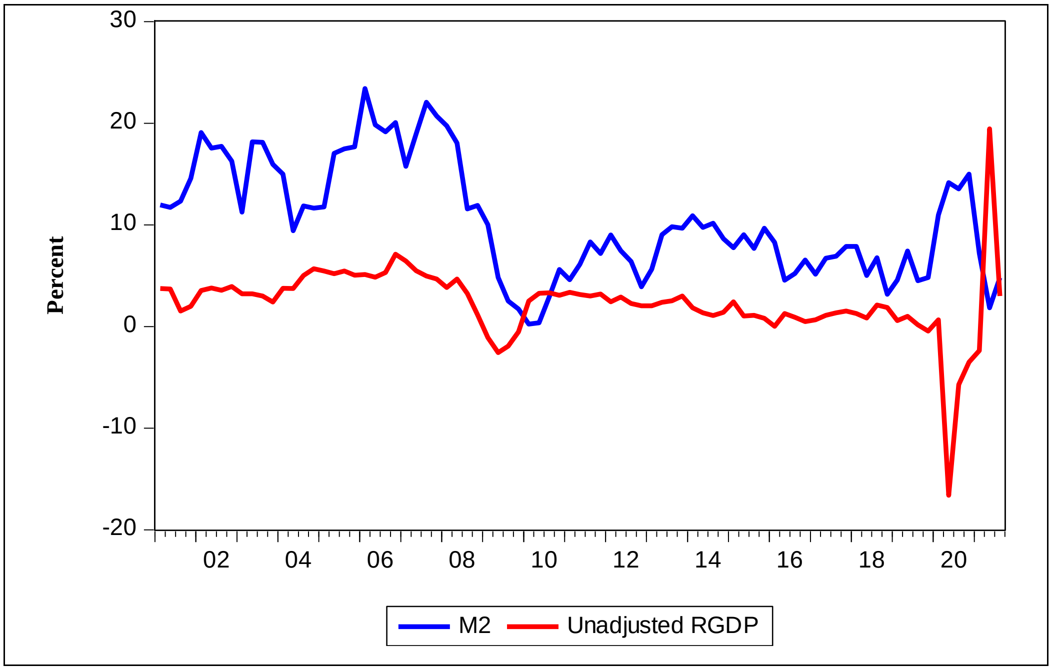
APPENDICES

Appendix 1: Selected South African Growth Rates (M2 and Unadjusted RGDP)



Appendix 2: Approval for Exemption from Ethical Clearance

University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneerspark
☎ +264 61 206 3111; URL.: http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

Approval for Exemption from Ethical Clearance

Ethical clearance exemption reference N0: DEC FOC/24/01

Review Date: 12/04/2023
Title of Project: **Assessing the Asymmetric Implications of the Common Monetary Area on the Stability of the Namibian Money Demand Function**

Student Name: Mr. Doughlas Mwangala Ndana

Student Number: **201207520**

Supervisor(s): **Dr. Canicio Dzingirai**

Dear Sir/Madam.

This letter certifies that the application for the procedure stated above has been reviewed by the Faculty of Commerce, Management and Law Decentralized Ethics Committee (DEC). The Ethics Committee has given due consideration and concludes that the said proposal be exempted from review as it does not involve direct contact with human participants and in addition your study relies on secondary data which does not require ethical clearance. This is aligned to the University research ethics policy on ethical exemptions page no.16 (C1.3). Please note that any changes to the procedure must be brought to the notice of the DEC. The DEC must determine whether the requested procedure changes alter the risks.

Please contact the DEC office if you have any questions. Any correspondence with the DEC office regarding this action should mention the allocated Ethical clearance exemption reference number indicated at the top of this letter.

Regards,

The ethics committee wishes you the best in your research.

Precious Mushendami (Decentralized Research Ethics Committee)

Prof. Davis Mumbengegwi ((Head, Multidisciplinary Research)