
**RESEARCH AND FINANCIAL STABILITY DEPARTMENT**

P O Box 2882, Windhoek, Namibia

Tel: +264-61-283 5111

Fax: +264-61-283 5231

E-mail: research@bon.com.na



# THE IMPACT OF FINANCIAL INNOVATION ON THE DEMAND FOR MONEY AND ITS IMPLICATIONS FOR MONETARY POLICY IN NAMIBIA

**Daisy Mbazima-Lando**

**Victoria Manuel**

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Enquiries related to this publication should be directed to:
The Chief Economist and Head of the Research and Financial Stability Department
P O Box 2882
WINDHOEK
NAMIBIA

Tel: +264 61 283 5111
Fax: +264 61 2835231
e-mail: research@bon.com.na

https://www.bon.com.na

## *Abstract*

*This paper investigates the impact of financial innovation on the demand for money and draws implications for monetary policy in Namibia. A money demand function is utilised to empirically test for the impact of financial innovation using the Engle-Granger two-step cointegration methodology while the CUSUM and CUSUM squares tests are employed to test the stability of the money demand function. The study uses time series data for the period 2002Q1 to 2019Q4 to test four financial innovation proxies namely, (stock market capitalisation + domestic credit) /GDP, M2/M1, PSCE/GDP and Bank Assets/GDP. The results reveal that the demand for money in Namibia is mainly determined by prices and interest rates and that the money demand function is unstable both without and with the inclusion of a financial innovation variable. The instability of the money demand function also confirms that the current monetary policy framework does not exclusively rely on full control of the broad money aggregate, due to the fixed exchange rate regime. Furthermore, findings from two proxies suggest that financial innovation has an impact on the demand for money and hence monetary policy but does not currently compromise its effectiveness as the demand for money persists. The policy recommendations for monetary policy relate to enhanced awareness and responsiveness of the monetary authority to the likely impact financial innovation might have on key monitored monetary aggregates, changes to their definitions and potential variations to the monetary policy transmission mechanism as economic and financial transactions become more complex in an increasingly digital global economy.*

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## 1. INTRODUCTION

**There is a broad consensus on what financial innovation means and the challenges it poses for central banks.** Financial innovation refers to *technological advances* which enable access to information, *trading as a means of payment*, the *emergence of new financial instruments and services,* and/or *more developed and complete financial markets*. According to Noyer (2007), financial innovation brings a lot of progress and should be welcomed in principle. However, it can also be a constant challenge for central banks due to the complex attributes it poses in the conduct of monetary policy, which might in turn impact its effectiveness (Misati et al., 2010).

**Financial innovation has had a positive impact on financial markets by facilitating more developed and complete markets.** Financial innovation is credited with creating more complete markets, improving resource allocation, and supporting longer-term growth prospects. In the case of the United States (US), it was perceived to reduce the volatility in growth by providing firms with more flexible financial structures and households with an enhanced ability to smooth their consumption in the wake of temporary changes in their income. Furthermore, deregulation and innovation in the housing finance markets in the US, enabled households to purchase houses whose values were consistent with their long-term income (Noyer, 2007). Noyer asserts that some critics point out that it enabled households to purchase houses whose values were beyond what their long-term income could support.

**Financial innovation, however, also tends to bring instability in the money demand and credit aggregates.** The introduction of new products and new intermediaries in financial markets tend to complicate the distinction between monetary and non-monetary variables. This is because consumers will often demand more of the high yielding non-monetary assets as opposed to the regular monetary assets and in turn, this substitution tends to destabilise the demand for money (Solans, 2003). For instance, the emergence of a new financial asset that is not included in the national definition of money but is high-yielding and liquid may result in a lower demand for money, and thereby upsetting the historically normal relationship between the quantity of money and income.

**According to Noyer (2007), the impact of financial innovation on the Euro, highlights its complexity.** There were signs of instability in the case of the Euro since 2001 as well as a break in the income velocity of M3, due to the influence of financial innovation. Financial innovation tends to affect money and credit developments by enabling banks to hedge credit risk and manage maturity and credit mismatches.

**Central banks need to closely monitor the developments in financial innovation as they may have significant implications for their role.** Firstly, developments in the financial sector may change the way the economy reacts to monetary policy. Secondly, the presence of financial innovation could affect the content of information that central banks regularly monitor, which serves as the basis for their policy decisions (Solans, 2003). Thirdly, the introduction of financial innovation could necessitate new regulations which might in turn compromise the effectiveness of monetary policy. Central banks might need to change their operating procedures from time to time in order to respond to the demands of financial innovation and ensure the sustainability of the financial system (Misati et al, 2010). Fourthly, central banks might be prompted to amend their monetary policy frameworks as was the case with the European Central Bank (ECB). The monetary policy strategy of the ECB includes an analysis of various monetary and non-monetary indicators and allows it to cross-check information from different sources using different approaches. This strategy attempts to consider the influence of financial innovation on the economy to better understand the risks to price stability in the Euro Area, and the impact on economic activity in general.

**To date, several innovations have emerged in the international payments system enhancing the ease of transacting.** The evolution of electronic trading (e-money[1]) as an alternative form of payment could potentially become or is already becoming a substitute for the traditional form of money. E-money therefore enhances the ease of transacting between the buyer and seller of a financial product. On the contrary, the use of electronic banking, debit and credit cards as conduits of financial innovation, were at the helm of disrupting the once stable relationship between the stock of money and nominal income (Misati et al, 2010). This instability

[1] According to the Payment System Determination (PSD-3), e-money is defined as "monetary value as represented by a claim on its issuer, that is i) stored electronically, ii) issued on receipt of funds, iii) accepted as a means of payment by persons other than the issuer and iv) is redeemable upon demand for cash in Namibia Dollar.
E-money can be issued through various access devices such as prepaid cards, internet, mobile phone or any other electronic device.

subsequently led to the abandonment of monetary targeting regimes by some countries according to Iris and Grimes (2003), cited in Misati et al. (2010).

## 2. RESEARCH OBJECTIVE

**This paper aims to assess the impact of financial innovation on the demand for money and draw policy recommendations for Namibia's monetary policy at a macro level.** The paper does so by empirically testing the impact of financial innovation on monetary policy through the stability of the money demand function, with and without financial innovation, after which policy recommendations are provided based on the findings of this study.

The remainder of this paper is organised as follows. Section III presents the financial innovations in the payment and banking systems. Section IV provides the theoretical and empirical literature review while Section V, VI and VII present the methodology, results, conclusion, and policy recommendations, respectively.

## 3. FINANCIAL INNOVATIONS IN THE NAMIBIAN PAYMENT AND BANKING SYSTEM

### 3.1 Payment Innovations in the Namibian National Payment System

**To review financial innovations in the Namibian banking system, key developments in Namibia's National Payments System which often work in tandem with those innovations in the banking sector are assessed.** In this regard, since its establishment in 2002, the National Payments System has undergone an evolution with several payment system reforms implemented. Namibia's own settlement system (NISS) was also established in 2002 and Namclear in 2003. In 2004, Namclear's preliminary objective was to clear all domestic EFT transactions. The cheque processing system was subsequently implemented in 2005. By April 2008, Namswitch (the Namibian Card processing system) enabled all inter-bank card transactions that emanated from automated teller machines (ATMs) to be cleared and processed locally while the clearing and processing of card transactions at point-of-sale (POS) terminals were effected in November of the same year (BON, 2019).

**Innovation-related developments that occurred in Namibia's National Payment System during 2012 to 2017 were largely consistent with observable global trends.** These included a swing towards the use of electronic payment methods, which include debit cards, credit cards, and electronic wallets whose use has become widespread. In contrast, the use of 'paper-based' methods such as cheques by consumers and businesses for transactional purposes declined, mainly due to the industry's initiative to phase out cheques as a means of payment (Van Rooyen, 2018). Table 1 in the annexure highlights the innovations and trends in the NPS over the last six years.

### 3.2 Banking Sector Innovations in the Financial Sector

**The Namibian banking sector underwent some innovations meant to improve the efficiency with which banks and their clients transact.** In this regard, most of the innovations were subsequently adopted by most commercial banks over the last nine years in the form of e-wallet services with cardless cash withdrawals having been effected by all the major commercial banks for use at their ATMs. The smart banking application is another innovation which affords 24-hour access to one's accounts on a profile, transacting between accounts, making prepaid purchases and conducting once-off or third-party payments, to mention but a few (Van Rooyen, 2018).

**When it comes to the availability of financial products that can be transacted electronically through the banking and /or financial system, an array of products exist such as wallets, EFTs and online banking.** These financial products are accessed through various channels such as ATMs, internet, and mobile phones. To date, the public can subscribe to and transact with various types of Money Market Funds and Unit Trusts which somewhat lessen the need for cash balances.

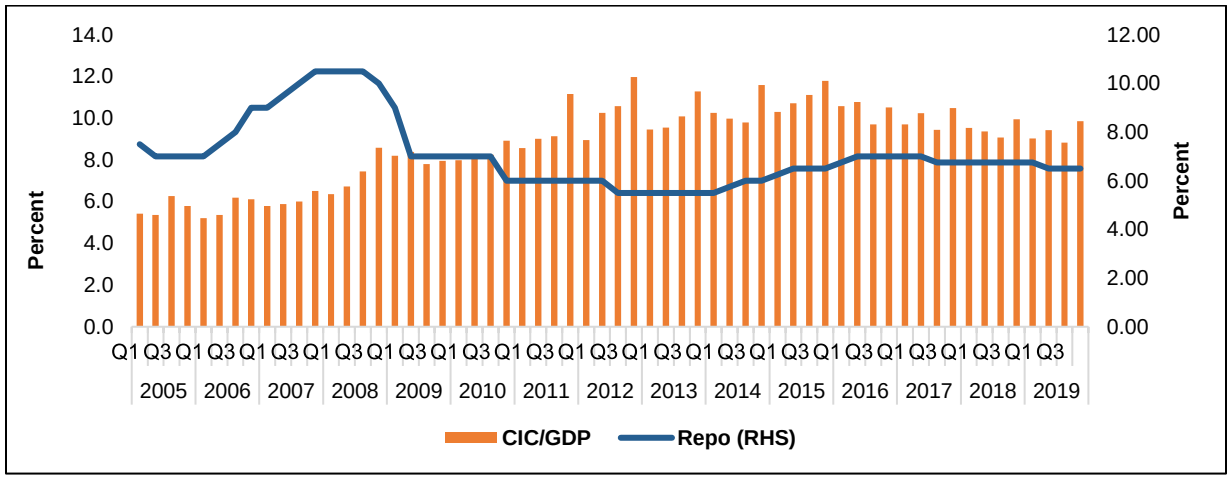
### 3.3 Review of Financial Sector Development and the Conduits of Financial Innovation in Namibia

**To gain an understanding of how financial innovation has evolved in Namibia, we analysed monetary variables and the conduits of financial innovation as depicted in the charts below.** The monetary variables that were selected besides the repo include the broadest measure of money supply (M2) in Namibia, currency in circulation (CIC) and claims by currency (national vs foreign currency). Aggregated data on the main commercial banks' loan book split into the

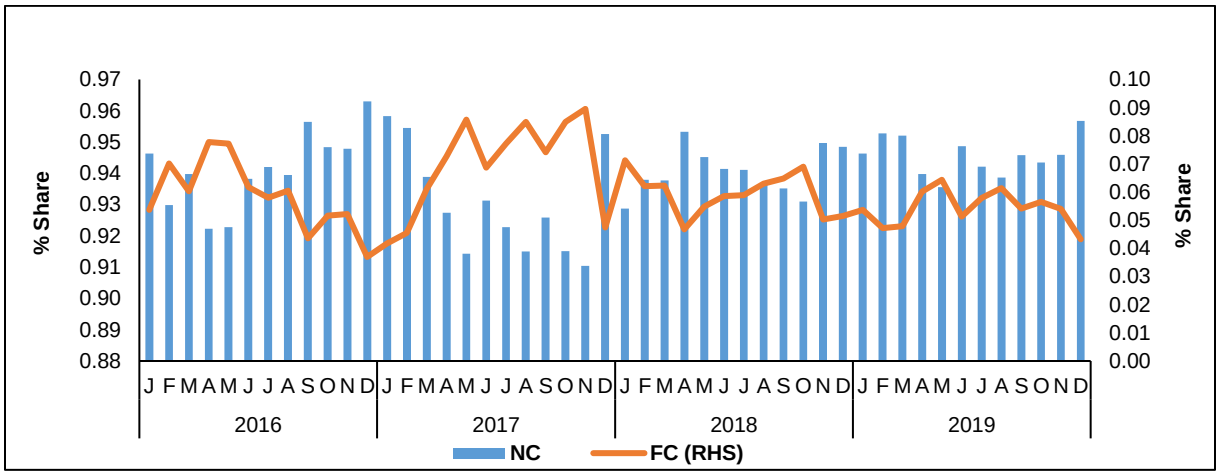
fixed and variable interest rate categories is also reviewed. Gross Domestic Product (GDP) is included to measure the relative impact of financial innovation on the aggregate economy. The non-monetary variables in this paper mainly refer to the "conduits of financial innovation" namely, the number of automated teller machines (ATMs), the number of electronic cards[2] issued to date, the number of merchants and the number of Point of Sale (POS) devices[3].

**Chart 1 (A-B): Monetary Variables**

**A) CIC/GDP vs Repo**




**B) Percentage Share of Claims in National and Foreign Currency to Total Claims**




Source: Bank of Namibia

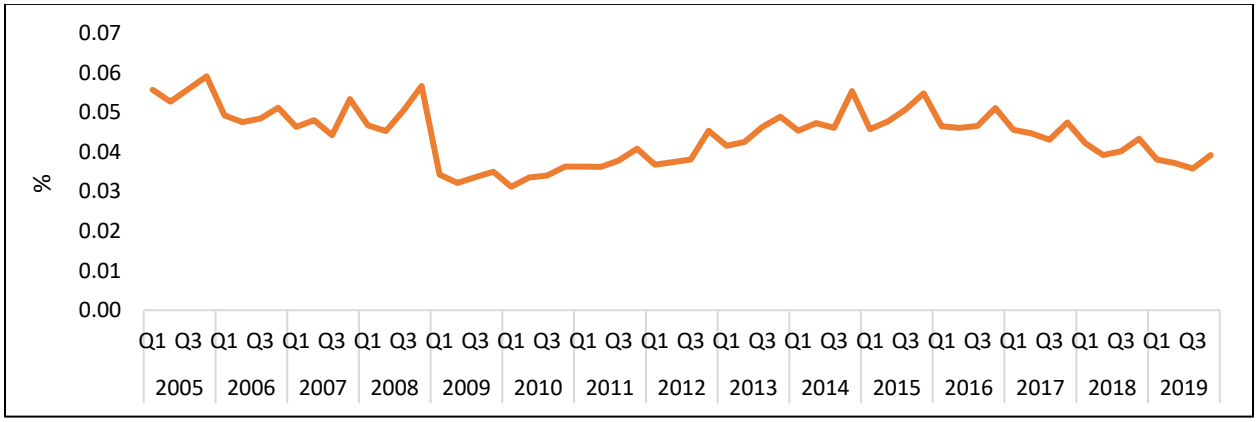
[2] Debit, prepaid, hybrid, and credit cards

[3] See Appendices

**From the above charts, the assumed movement of financial innovation to monetary and economic variables is mixed.** Firstly, the increasing ratio of CIC/GDP when plotted against the repo seems to imply that financial innovation has not had much of an effect as the population increased their holding of notes and coins. However, this can also reflect an increase in transactional demand due to innovative products such as the use of ewallets. When a comparison is drawn between two periods (low vs high interest rates), during period of high interest rates, i.e. from 2005 to 2010, consumers held less notes and coins relative to the period of low interest rates, i.e. from 2010 to 2014 (Chart 1 A). The former could additionally be due to the impact of the global financial crisis while the latter could have occurred due to the effects of an expansionary fiscal policy, namely TIPEEG, resulting in a two-fold effect with the low interest rates. Theoretically, the above developments are in line with the Keynesian theory of money demand.

The high ratio of claims in national currency relative to foreign currency would imply that monetary policy is still highly effective in influencing the domestic economy, despite the choice that financial innovation presents to alternatively holding these claims in foreign currency (Chart 1 B).

**Chart 1 (C): CIC/M2 ratio**




Source: Bank of Namibia

**On aggregate, the decline in the ratio of CIC/M2 can be broadly assumed to show conformity to financial innovation. However, the results are mixed when the ratio is analysed in segments.** During the period from 2005 Q1 to 2009 Q1, the ratio was much higher than the subsequent period from 2009 Q1 to 2012 Q3. This implies that in the former period, financial innovation is assumed to have been less effective in influencing the choice of transacting while at the same time, if the level of financial and banking sector development is taken into consideration, it would support the receptibility of financial innovation as a means of transacting. Similarly, the decline in the ratio in the following period could indicate an increased need to

transact via the financial and banking system and hence can be assumed to show conformity to financial innovation. From 2012 Q4 onwards, the rise and fall in the ratio indicates fluctuating responses as previously alluded to (Chart 1 C). Overall, the underlying effect of interest rates cannot, however, be ruled out as in the previous analysis.

**On average, variable interest rates on the commercial bank's balance sheet constitute over 75 percent.** As most bank lending is at variable interest rates, the interest rates set by the Bank of Namibia and filtering through to the banks' lending and deposit rates have an impact on the bulk of bank business in Namibia, both on the asset and the liability side of the banks' balance sheet.

**The conduits of financial innovation have portrayed a rising trend over the past five years.** Data presentation[4] on some key conduits of financial innovation from the main commercial banks in the country, show that over the last five years up to 2019, a rising trend is noted. There has been a steady rise in the number of ATMs[5], Merchants, Point of Sale devices and Electronic[6] cards which indicates the receptivity of financial innovation as a means of doing business.

**In summary, the descriptive analysis presents varying degrees of the influence of financial innovation on monetary variables in Namibia**. This is due to its conformity only in specific periods. The mixed picture emanates from the increasing ratio of CIC/GDP that could suggest an increased or decreased influence of financial innovation on the holding of cash, while the same notion of an increasing or decreasing CIC/M2 ratio can be analysed in the same way. The effect of interest rates appears to play an additional role, such that the developments discussed herein, might not exclusively be to the assumed effect of financial innovation. In addition, due to variations in the degree of development in banking and financial markets between the developed and developing world, the precise impact of financial innovation on the demand for money and ultimately monetary policy, is best left to empirical testing.

[4] See appendices
[5] The observed decline between 2017 and 2018 was mainly due to the closure of SME bank.
[6] The observed declined between 2016 and 2017 was mainly due to the implementation of the chip and pin cards at the time.

### 3.4 Namibia's Monetary Policy Framework

**Namibia's monetary policy framework is submissive to the peg and as such, it ceded its right to an independent monetary policy**. Namibia's monetary policy framework is underpinned by the fixed currency peg to the South African Rand which governs the conduct of monetary policy and where the monetary authority mainly uses the repo rate to influence policy. Namibia's monetary policy transmission mechanism therefore runs from the repo rate, to market lending rates, with the aim of ensuring price stability in the interest of sustainable growth and development. Maintenance of the fixed peg, which is the intermediate target, ensures that the goal of price stability is achieved by importing stable inflation from the anchor country. Furthermore, the relationship between monetary policy and the exchange rate policy in an open economy operating under a fixed exchange rate regime is underpinned by the "impossible trinity" concept. The concept postulates that a country cannot simultaneously enjoy a fixed exchange rate, monetary policy independence, and an open capital account. Consequently, under a fixed exchange rate arrangement, a country cannot operate monetary policy independently from the anchor country. As such, Namibia has limited monetary policy independence due to the fixed exchange rate arrangement.

## 4. LITERATURE REVIEW

### 4.1 Theoretical Literature

#### Traditional Theories of Demand for Money

**There are a range of theories explaining how the demand for money works in the real economy.** Understanding these theories will assist with assessing the possible implications that financial innovation might have on the demand for money and ultimately monetary policy. *Classical theorists* argued that demand for money is mainly dependent on the volume of transactions in the economy as reflected in Fisher's quantity theory of money. According to Tillers (2004), the definition implied by the theory assumes that the velocity of money depends on the quantity of money in circulation and nominal income of the economy. It further follows that the velocity of money is influenced by institutional and technological factors, whose effects adjust slowly over time. As a result, if the velocity of money is constant in the short run, the quantity of money depends on nominal income only.

The *Keynesian theorists* emphasise the importance of interest rates in determining the demand for money and advocate that individuals hold money for transaction, precautionary and speculative motives. Laidler (cited in Shidhika, 2015) suggested that both transaction and precautionary motives depend on the level of income, whereas the speculative motive for holding money arises from the desire to maximise wealth, which in turn depends on interest rates.

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

*Friedman's modern quantity theory of money* rests on the concept that demand for monetary assets is directly related to permanent income and indirectly related to the expected differential returns from bonds and stocks (equities). In this regard, Friedman believed that money would increase or decrease as the return on bonds and stocks and goods increased or decreased and that interest rates did not matter much. In this way, Friedman's theory proved superior to Keynes as it was based on various forms of wealth, tastes and preferences of asset holders.

## Financial Innovation and the Demand for Money

**According to Apere (2017), the growth in financial innovation has potential to enhance efficiency in an economy but can pose instability in the demand for money.** Historically, to achieve the ultimate goal of price stability, central banks required a stable money demand function or understanding the causes of the instability as was the case with the with regard to the European Central Bank discussed earlier. Most central banks now work with a framework where they set their primary interest rate to affect lending and domestic interest rates, credit extension, aggregate spending and ultimately inflation. Although money has become less important compared to the 1970s and 1980s, it still possesses important information for central banks. This is mainly because the stability of money demand plays a key role in the conduct of monetary policy especially in terms of the appropriate monetary policy actions (Sriram cited in Apere, 2017). However, it can also complicate the way monetary policy is conducted due to the instability of the money demand.

**The effect of financial innovation on money demand depends on the form of innovation taking place**. Dunne and Kasekende (2016) postulate that different forms of financial innovation can have different effects on money demand. For instance, ATMs/ debit cards or derivative financial instruments may potentially enhance efficiency and reduce transaction costs, as cash that would have been carried in wallets is substituted by these innovations and this could lead to a decline in demand for cash. On the contrary, financial innovations could potentially lead to an increase in money demand if payment systems improve but economic agents demand more liquid assets. This would occur where individuals demand electronic money and cash through the use of cellphone technology but do not necessarily move away from more liquid assets to less liquid assets (Dunne and Kaskende, 2016).

**The way financial innovation influences the demand for money can be complex**. According to Shidhika (2015), financial innovation eroded the distinction between banks and other financial intermediaries and between intermediated transactions and market ones. Some new financial assets created by innovation are close substitutes for the traditional "medium of exchange" assets, which is comprised in the definition of money. While the role played by shadow banking is an important area of research, it is beyond the scope of this paper and warrants a separate dedicated study to determine its stance in Namibia. The role played by "shadow banks" in credit intermediation and their potential impact on monetary policy remains a vital focus area.

### 4.2 Empirical Literature

**The demand for money is important in the conduct and determination of the effectiveness of monetary policy.** Adegboye et al (2010) examined whether the financial innovations that occurred in Nigeria after the Structural Adjustment Programme of 1986 had affected the demand for money. The study used M2 as the dependent variable, while GDP, nominal interest rates (Time deposit and treasury bills), CPI and a dummy variable (representing the financial innovation that had taken place in Nigeria since the sweeping reforms of the Structural Adjustment Programme (SAP) embarked upon by Nigeria in 1986) served as independent variables. In addition, the study used the Engle and Granger Two-Step Cointegration technique, with data from 1970-2008. The results from the study showed that "the financial sector liberalisation which was one of the goals of the SAP, did not lead to financial innovation which would have benefitted banking customers,

deepened the money market and affected the effectiveness of monetary policy''. The study concluded that financial innovation had no significant impact on the demand for money in Nigeria.

**The National Bank of Rwanda (2016) determined that financial innovations do not play an important role in determining money demand in the long run.** Using the ratio of M3/M2, bank concentration and private sector credit as a percentage of GDP as measures of financial innovation, the National Bank of Rwanda empirically examined the possible impact of financial innovation on the conduct of monetary policy in Rwanda. The study focused on the stability of the money multiplier and the velocity of money as financial innovation may lead to instability of the two variables. The study estimated impulse response functions in two separate samples. Results showed that M3 and GDP have a long-run relationship although the structural change in the relationship between the two variables because of financial innovation, may reduce the effectiveness of monetary policy. The study concluded that financial innovations do not play an important role in determining money demand in the long run.

**Ma and Lin (2016) argue that the effectiveness of monetary policy declines as the financial system becomes more developed.** To investigate the relationship between financial development and the effectiveness of monetary policy, Ma and Lin (2016) used panel data of 41 economies over 2005Q1 to 2011Q4 and employed a pooled least squares, fixed effect and random effect to estimate coefficients in panel data analysis. The study concluded that the effect of monetary policy on output and inflation are significantly and negatively correlated with financial development, signifying that the effectiveness of monetary policy declines as the financial system becomes more advanced.

**Financial innovation enhances the interest rate channel of the monetary policy transmission and the efficiency of the financial system.** To examine the implications of financial innovation on Nigeria's monetary policy, Tule and Oduh (2016) measured financial innovation as the aggregation of the value of transactions on e-based platforms that affect demand deposits. The study used trend analysis, an error correction mechanism and a structural model estimated with Generalised Method of Moments (GMM), using monthly series data from January 2009 to February 2015. The paper established that financial innovation improves the interest rate channel of the monetary policy transmission and the efficiency of the financial system. However, this efficiency adds an element of uncertainty in the monetary policy

environment as monetary aggregates may be unstable and therefore make it difficult to understand the behaviour of interest rates.

**In the context of Namibia, a few studies focused on the examination of the demand for money, mainly because it is crucial in the formulation of monetary policy and its implementation.** Ikhide and Katjomuise (1999) estimated the money demand function by employing the cointegration and error correction methodology using quarterly data for the period 1990 to 1998. The study used variables such as M2, interest rates (treasury bills, deposit rate and long-term bond rate), GDP, CPI, and real exchange rate. The study revealed that real money balances, income and interest rates had stable relationships. Mabuku (2009), investigated the stability of money demand in Namibia using quarterly time series data from 1993 to 2006 and found that both M1 and M2 have stable long-run relationships with income, the interest rate, CPI and exchange rate. Shidhika (2015) employed a VAR using data from 2000Q1 to 2013Q4 to study the effect of financial innovation on the demand for money and established convergence in the variables that explain the demand for money, which confirmed the stability of money demand in Namibia. Sheefeni (2016) scrutinised the demand for money in Namibia using the unit root test, cointegration and Autoregressive Distributed Lag techniques. The study used (M1 and M2), real income, inflation, and interest rate variables to test the relationship, with data for the period 2000Q1 to 2012Q4. The study found no long run relationship over that period among the variables. In this regard, as the money demand function was already tested by the mentioned authors, evidence from Namibia is inconclusive if Sheefeni's 2016 study is considered. This study modifies the standard equation to include and test for the effect of financial innovation as stipulated later in the empirical methodology.

## 5. METHODOLOGY

### 5.1 Empirical Methodology

**The empirical methodology assesses the effect of financial innovation on M2 and ultimately monetary policy using a money demand function.** The paper utilises the money demand function to test the effect of financial innovation and the scope it has for monetary policy.

**There are various ways to measure financial innovation.** Most authors in developing economies such as Dunne and Kasekende (2016) have modelled financial innovation by using

the ratio of M2/M1[7], domestic credit/GDP and bank assets[8]/GDP ratio (King'ori, 2003). Other proxies such as (domestic credit + stock market capitalisation)/ GDP measure the overall development of the financial sector (i.e. the level of development of banks, non-banks, and financial markets). Other approaches model financial innovation based on new financial products associated with innovation, for instance using the number of ATM terminals and securitisation to represent financial innovation. At the time of drafting this paper and in the case of Namibia, there was a lack of long time series data on most of the technological measures of innovation herein referred to as "conduits" such as ATMs, E-cards, POS devices etc.

**This study used and tested four macro-level measures of financial innovation.** This paper tests four widely cited macro-level proxies for financial innovation, (i.e. (stock market capitalisation + domestic credit) /GDP, M2/M1, domestic credit[9] /GDP and bank assets/GDP) in order to make an inference regarding their effect on M2 and ultimately monetary policy.

**While this first proxy used to measure financial innovation was deemed the most comprehensive (next to the bank assets/GDP) of the four choices, it is not without some shortcomings.** Even though the market capitalisation of the NSX provides an indication of financial deepening, as it measures the total value of a company's stock, it however does not measure the underlying value of innovative products traded. Furthermore, the underlying value of innovative products traded would need to be primarily listed and traded on the NSX to be beneficial as a proxy to this study or subsequent ones. In addition, due to the sheer size of all trading on the NSX , a single big firm listing or delisting its shares on the stock exchange, can move the (stock market + domestic credit capitalisation)/GDP ratio strongly up or down, without anything else suggesting that it is due to innovation or a lack of it.

[7] Dunne and Kasekende (2016) justify the use of this proxy by stating that as financial innovations grow, individuals tend to move away from more liquid assets, which are reflected in M1, to less liquid assets, which are reflected in the non-M1 part of M2 which is taken to signify financial innovation. This was also the consensus with Malik & Aslam (2011) and other authors such as Qamruzzaman and Jianguo (2017)

[8] According to the World Bank, it is a more comprehensive measure of size, because it not only includes credit to private sector, but also credit to government as well as bank assets other than credit.

[9] Private sector credit extension

**Stability of Money Demand in Namibia**

**The study adopted the Namibian money demand function as specified by Ikhide and Katjomuise (1999) as well as Mabuku (2009).** Several studies such as Shidhika (2015), Sheefeni (2013), Mabuku (2009) and Ikhide and Katjomuise (1999) examined the demand for money function in Namibia. Ikhide and Katjomuise (1999), Mabuku (2009) and Shidhika (2015), found that the demand for money function was stable. Moreover, Ikhide and Katjomuise (1999) found that interest rates were one of the important determinants of money in addition to income (real GDP) in Namibia. The stability of the money demand function was deemed essential for the conduct of effective monetary policy through its ability to predominantly influence monetary aggregates, although we know that this focus has since shifted for most economies. This study, therefore, adopts the money demand function as specified by Ikhide and Katjomuise (1999) and the theoretical methodology proposed by the National Bank of Rwanda (2016) in order to assess the impact of financial innovation on the demand for money and ultimately the effectiveness of monetary policy. The Namibian real money demand function is, therefore, expanded to include the financial innovation variable.

## 5.2. Model Specification

**The demand for money curve tests the relationship between the quantity of real money demanded and the opportunity cost of holding it**. Theoretically, the quantity of money held is determined by the level of prices, interest rate and real income.

Following the Keynesian model of money demand and Ikhide and Katjomuise (1999), the basic money demand model for Namibia is modified to enable the assessment of financial innovation[10] on monetary policy and is expressed as follows:

$$lnM2_t = \beta_0 + \beta_1 lncpi_t + \beta_2 lny_t + \beta_3 lnSAtb_t + \beta_4 lnNAtb_t + \beta_5 lnDR_t + \beta_6 lnNEER_t + \beta_7 lnFIN_t + \varepsilon_t \quad \text{.....(1)}$$

Where;

Where: lncpi is a log of consumer price index representing the price level, lny is a log real GDP (real income), SAtb represents South Africa Treasury Bills rate, NAtb is Namibia Treasury Bills rate, lnDR is the deposit rate on the six months commercial bank deposits, and NEER is the

[10] Each financial innovation proxy is tested, and the model is re-run to obtain the regression results.

NEER nominal effective exchange. $\beta_0$ is a constant, $\beta_1 \, to \beta_7$ are long run coefficients and FIN represent financial innovation while $\varepsilon_t$ is an error term.

## Variables and Data

**The study used quarterly time series data for the period 2002Q1-2019Q4**. Quarterly data for most variables was collected within the Bank of Namibia, while CPI and real GDP data were obtained from the Namibia Statistics Agency (NSA).

***M2*:** is the total stock of money (broad money) in Namibia. M2 contains M1, which includes overall cash balances (notes and coins) held by the public.

***Interest rate:*** The monetary policy of Namibia uses the **Repo rate** to influence changes in the supply of money through commercial bank lending rates. Due to this practice, the interest rate channel of the monetary policy transmission plays an important role in the macroeconomy. Changes in nominal interest rates are expected to influence real rates and eventually the cost of holding money. It is theoretically expected that high interest rates will have a negative impact on real money demand. As with Ikhide and Katjomuise (1999), alternative interest rate measures are used in this study for the money demand function. The **deposit rate on the six-month deposits** at the commercial banks, is considered representative of the interest on savings and time deposits. The third is the **short-term treasury bills rate**. Both the Namibian series and the South African series are used in this study, mainly to ascertain the relevance of the return on foreign opportunity costs - in this case, the South African Treasury bill rate - to the demand for money in Namibia. This is due to the close financial integration between Namibia and South Africa. Money market conditions in the Namibian market respond to those in South Africa (Ikhide and Katjomuise,1999).

***Price level (CPI):*** Namibia consumer price index is used to represent the price level/inflation. It is expected the demand for money decreases with increases in prices and vice versa.

***Real income:*** Real Gross Domestic Product (GDP) is used to represent real income. It is theoretically expected that GDP has a positive effect on money demand as the real money demand increases as real income increases.

***Exchange rate:*** defines the rate of return to holding foreign currency in Namibia. The nominal effective exchange rate (NEER) is used and expected to have a positive effect on money demand.

***Financial innovation***: is defined more broadly to include the ratio of (stock market capitalisation + domestic credit)/GDP, M2/M1 and domestic credit/GDP. This study therefore individually tests the stated proxies to determine their effect on monetary policy.

### 5.3. Estimation Technique

**This paper empirically assesses the impact of financial innovation on M2 and ultimately monetary policy in Namibia using the Engle-Granger cointegration method.** The Engle-Granger cointegration methodology (1987) is a single-equation method which tests for a cointegrating relationship between variables. The precondition to examine cointegration is that variables must both be non-stationary and integrated of the same order.

The Engle-Granger (EG) cointegration method can be performed as follows:

$$Z_t = \hat{Z}_t + \mu_t = \hat{\beta}_0 + \hat{\beta}_1 Y_t + \mu_t \quad (2)$$

The Engle-Granger technique relies on the existence of a long-run relationship between the variables *Z* and *Y*. This depends on the error term being stationary and the residuals from equation 4 are derived as follows:

$$\mu_t = Z_t - \hat{Z}_t \quad (3)$$

The unit root tests are used to test if the residual obtained from equation 5 is stationary. If the residual is stationary, it implies that there is cointegration between the variables Z and Y. Confirmation of stationarity of the residuals suggests that variables are cointegrated and it is appropriate to proceed to the estimation of the short run error correction (ECM) model to obtain the error correction term. The ECM is expressed as follows:

$$\Delta Z_t = \gamma_0 + \gamma_1 \Delta Y_t + \eta ECM_{t-1} + \mu_t \quad (4)$$

Where $\Delta$Z and $\Delta$Y indicate that the variables are in difference form and are assumed to be integrated of order one or I (1). The coefficient of the $ECM_{t-1}$, $\eta$ represents the speed of adjustment to equilibrium. The $ECM_{t-1}$ is a lagged residual from equation (4). This coefficient measures the speed of adjustment of any deviation in the short run back to the long run

equilibrium. It is also expected to be negative and statistically significant if there is an adjustment to equilibrium.

## 5.4 RESULTS

**This section summarises the results of the study.** The study employed the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests, to carry out a series stationarity tests on all variables in levels and first differences including both a constant and intercept. At levels, both tests revealed that variables were non-stationary. However, after first differencing all variables, both tests rejected the hypothesis of non-stationarity and the results concluded that all variables were integrated of the same order I (1[11]).

### Long Run Estimation of the Money Demand Function

The following is the estimated long run money demand function for Namibia:

$$lnM2_t = -1.66 + 2.27lncpi_t + 0.14lny_t - 0.08tbn - 0.11dr + 0.11SAtb + 0.24lnNEER_t \dots\dots\dots\dots (5)$$

(0.48)[12] (0.0) (0.59) (0.0) (0.0) (0.0) (0.48)

**Prices and interest rates are found to be the determinants of money demand in Namibia.** The estimated coefficients for the income level and nominal exchange rate are positive as per theoretical expectation, but statistically insignificant at 5 percent. The estimated coefficient for CPI is positive and significant, violating theoretical expectations and contrary to the results of Mabuku (2009), but in agreement with Ikhide and Katjomuise (1999). The estimated coefficient of the treasury bill rate in South Africa, is positive and statistically significant, which implies that an increase in South Africa's Treasury bill rate will result in an increase in money demand in Namibia. This is, however, practically unexpected, as an increase in South Africa's treasury bill rate is more likely to result in an increase in the M2 deposit withdrawals required to purchase South African treasury bills. On the contrary, an increase in Namibia's treasury bill rate will result in a decrease

[11] See Table 1 in Appendices.
[12] Figures in brackets represents P-values.

in money demand in Namibia, as consumers will move their funds to invest in long-term securities. These findings are consistent with Ikhide & Katjomuise (1999), which implies that the Namibian market responds to both changes in Namibia and South African interest rate. As theoretically expected, the deposit rate is negative and statistically significant, which suggests that an increase in the deposit rate reduces the incentive of holding money in Namibia and vice versa.

## Financial Innovation and Demand for Money

### Long run estimation[13] of money demand function with financial innovation proxied by (stock market capitalisation[14] + domestic credit)/GDP

**Empirical results suggest that financial innovation has a negative and significant impact on money demand in Namibia (Equation 6).** The results show that the signs of all independent variables in the money demand function are consistent with the results obtained in the original long run equation. The coefficient of financial innovation in this case is found to be negative and significant implying that financial innovations that took place thus far in the financial sector resulted in a decrease in the demand for money as part of it might be channeled through stock market investments, particularly by large corporations. In this regard, the impact on monetary policy should not be compromised as the demand for money is simply diverted to alternative forms of investment, thus still rendering it effective.

The paper additionally tested four variants of potential financial innovation variables that were deemed applicable to the Namibian context from the NSX. These were the *total value of listed bonds*, *ratio of (the total value of listed bonds + domestic credit)/GDP*, *the market captialisation of the free float*, and ratio of (*market capitalisation of the free float + domestic credit)/GDP*. The results showed that only financial innovation proxied as the ratio of (*market capitalisation of the free float + domestic credit)/GDP* had a negative and significant impact on the demand for money in the long run but short run results proved insignificant. The rest of the variables had a negative yet insignificant result while the market capitalisation of the free float was found to have a positive but insignificant impact on money demand.

[13] All subsequent long run equations with the financial innovation variable that follow are in the Annex.
[14] The local NSX market capitalisation data was used.

### Long run estimation of money demand function with financial innovation (M2/M1)

**Empirical results show that financial innovation has a positive and significant impact on money demand in Namibia (Equation 7).** Financial innovation in this case was defined as a ratio of broad money to narrow money (M2/M1). The results show that the signs of all independent variables in the money demand function are consistent with the results obtained in the long run equation, however, real income is significant while the exchange rate remained insignificant. The coefficient of financial innovation is found to be positive and statistically significant, implying that despite the current innovations in the banking sector, individuals continue to increase their demand for money. This could be explained by the increase in transactional demand that arises from the demand of innovative financial sector products such as ewallets, cellphone banking and MobiPay investments. This should not comprise the effectiveness of monetary policy as the demand for money persists. According to Dunne and Kasekende (2016), a negative and significant relationship is theoretically expected on the premise that individuals will move away from more liquid assets (M1) to less liquid assets (M2). However, the impact of financial innovation depends in the type of innovation taking place and might be country specific.

### Long run estimation of money demand function with financial innovation (Private domestic credit/GDP)

**Empirical results suggest that financial innovation has a negative yet insignificant impact on money demand in Namibia (Equation 8).** The results show that the signs of all independent variables in the money demand function are consistent with the results obtained in long run equation. The coefficient of financial innovation is found to be negative and insignificant concurring with findings of Dunne and Kasekende (2016). Shidhika (2015) also used and tested the proxy, PSCE/GDP, but found a positive yet insignificant relationship to money demand, implying that financial innovation (at least proxied this way) may not have an impact on the demand for money in Namibia.

## Long run estimation of money demand function with financial innovation (bank assets[15]/GDP)

**Empirical results suggest that financial innovation has a positive yet insignificant impact on money demand in Namibia (Equation 9).** The results show that the signs of all independent variables in the money demand function are consistent with the results obtained in the long run equation. The coefficient of financial innovation is found to be positive and insignificant implying that financial innovations that took place thus far in the financial sector have resulted in individuals demanding more money at the very least despite the idea that no inference can be made due to these insignificance of the results.

## Cointegration test

**The model confirms a long run relationship between M2 and all the independent variables.** In order to test for a long run relationship, the residuals obtained from the long run equations are tested for stationarity using the ADF test. If the residuals are stationary, then it is possible for cointegration to take place among the cited variables. The results of the unit root test for the residuals are presented in Table 2 below.

### Table 2: Augmented Dickey-Fuller test (levels and intercepts)

| | **t-statistics** | **Probability** | |
|---|---|---|---|
| Residual 5* | -4.816734 | 0.0002 | *Confirms cointegration* |
| Residual 6* | -4.837433 | 0.0001 | |
| Residual 7* | -3.724395 | 0.0057 | |
| Residual 8* | -4.83743 | 0.0001 | |
| Residual 9* | -4.87645 | 0.0001 | |

*Corresponds to the equation number estimated above with 7 been the original long run equation.

**The model confirms a long run relationship between M2 and all the independent variables.** The results show that residuals from all long run equations are stationary in levels. This implies that there is a long run relationship between the dependent variable (M2) and its independent variables. The model continued to step two, to estimate the error correction model (ECM).

[15] Commercial Bank Assets

## Short run results

**The results in Table 3 show that the estimated error correction term (ECT) of equation 5 is negative and significant.** The coefficient of the error correction term of the original long run equation without financial innovation is negative and significant at a 5 percent significant level, confirming that co-integration exists between variables. About 15 percent of deviations from the long run equilibrium are corrected back to its long run equilibrium. All dependent variables are statistically significant, while the real income is statistically insignificant. Additionally, the ρ value of the F-statisitics is almost zero (highly significant), implying that real GDP, interest rates, CPI and exchange rate together have an effect on money demand. The Durbin-Watson (Dh) statistic of 2.32, means that the model does not suffer from serial correlation. The ARCH heteroscedasticity test of the squared residuals on lagged values and a constant show no evidence of the presence of heteroscedasticity. On the contrary, the null hypothesis of residual being normally distributed may not be rejected.

### Table 3: Error correction model of equation 9

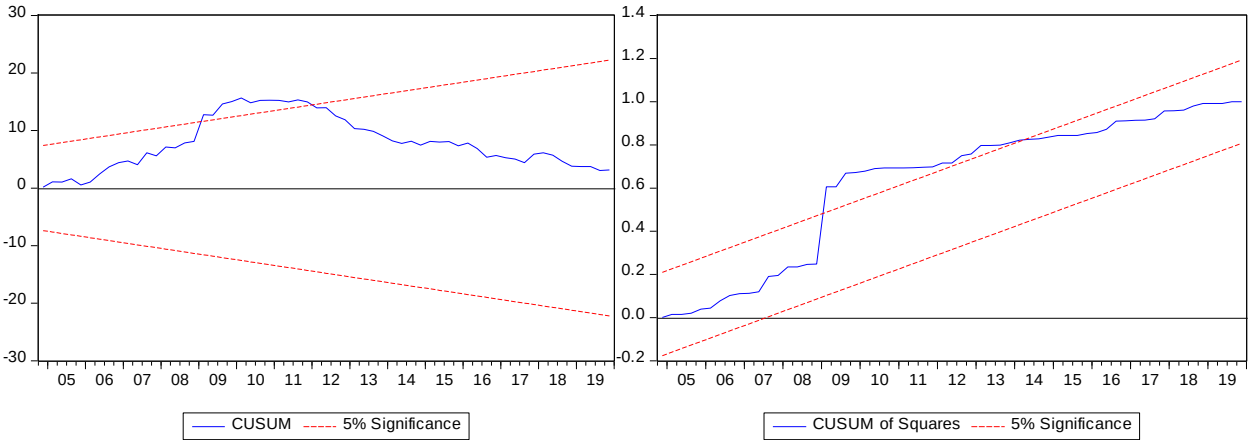
| **Variable** | **Coefficient** | **t-Statistic** | **Prob.** |
|---|---|---|---|
| D(LNGDP) | -0.287405 | -0.509376 | 0.6123 |
| D(LNER(-1)) | -0.587639 | -1.950088 | 0.0558 |
| D(LNCPI(-2)) | 1.619937 | 2.158017 | 0.0349 |
| D(TB(-2)) | 0.049774 | 3.547957 | 0.0008 |
| D(DR) | -0.064171 | -4.159695 | 0.0001 |
| D(SATB(-2)) | -0.029446 | -2.266977 | 0.0269 |
| ECM(-1) | -0.151029 | -2.004661 | 0.0494 |
| C | 0.009439 | 0.709494 | 0.4807 |
| $R^2$= 0.460554<br>Adjusted $R^2$= 0.39865 | | Durbin-Watson 2.321445<br>F-statistics 7.439844 (0.00) | |
| ARCH test<br>F (2,64)<br>P-value (0.9197) | | Jaque - Bera 65.65<br>Probability 0.00 | |

**The short run models with financial innovation also adjust back to long term equilibrium (Table 4-6[16])**. In the short run, the error correction term from the equations with the financial innovation variable indicate that, about 16 percent, 28 percent, 16 percent and 15 percent of the deviations from long run relationship of the money demand function respectively are adjusted back to its long-run equilibrium every second quarter.

## Stability test of the money demand function

**There is some instability in the estimated money demand function.** After confirming the existence of a long run relationship of the money demand and the relationships between dependent and independent variables, the CUSUM and CUSUM square tests of stability were used to test if the long-run money demand function was stable or not.

**Figure 1: Cusum and Cusum square plot for money demand function**




**The CUSUM and CUSUM square test results reveal that both models, with and without financial innovation, produce an unstable money demand function.** The results displayed some level of instability in the money demand function during the period from 2009 to 2014 (Figure 1). This instability can be attributed to the global financial crisis which mostly affected the financial sector. Similarly, the money demand function remains unstable with the inclusion of all the four financial innovation proxied variables (Figure 2-5[17]). There were a couple of key developments in the payments system from 2012[18] which can be associated with the level of technological progress in the financial sector and that may lend support to the noted extended instability of the

[16] See appendix

[17] See appendix

[18] See appendix on "Innovations in the NPS (National Payments System)"

money demand functions. Both the CUSUM and CUSUM square tests of stability remained consistent with the first result of the money demand function without financial innovation.

**The Namibian money demand function provides important information on key monetary aggregates despite the prevailing exchange rate regime.** In economies where monetary targeting is still being pursued, such instability would likely compromise the effectiveness of monetary policy. As mentioned earlier, although most economies have since migrated to alternative monetary policy regimes, such as inflation targeting or variations thereof, the traditional money demand function as utilised in this paper continues to provide important information on key monetary aggregates which remain relevant to most regimes. Furthermore, the finding of an unstable money demand function in the context of Namibia's monetary policy regime verifies that the current monetary policy framework does not exclusively rely on the full control of broad money. This is attributed to Namibia's prevailing fixed exchange rate regime which governs the conduct of monetary policy and where the monetary authority mainly uses the repo rate to conduct policy.

## 6. CONCLUSION AND POLICY RECOMMENDATIONS

**The main objective of this paper was to investigate the impact of financial innovation on the demand for money and assess the implications for monetary policy in Namibia.** The paper employed the Engle-Granger two-step cointegration test, CUSUM and CUSUM squares test to analyse the stability of the money demand function as this is one of the traditional monetary policy tools used to assess central bank's core objective. The period of analysis was from 2002Q1 to 2019Q4. The findings revealed that the money demand function is unstable and concluded that the demand for money in Namibia is mainly determined by prices and interest rates. These results are consistent with the findings of Ikhide and Katjomuise (1999). The study further determined that the instability of the money demand function in certain periods could be attributed to the effects of the global financial crisis and innovations that had so far taken place in the payments system.

**Regarding the effect of financial innovation on the demand for money, four macro-level proxies were tested with the results for two been inconclusive.** The results using the (stock market capitalisation + domestic credit)/GDP proxy showed that financial innovation has a negative and significant impact on money demand pointing to the receptibility of largely corporate investors in channeling their investments through the stock market in the case of Namibia. Furthermore, using the M2/M1 proxy, it emerged that financial innovation has a positive and significant impact on money demand in Namibia. This signifies that despite the current innovations that have taken place in the banking sector, individuals and corporates continue to increase their demand for money. The positive finding could further be explained by the increase in transactional demand that arises from the demand of innovative financial sector products such as eWallets, cellphone banking and MobiPay investments in the country.

While these findings suggest that financial innovation has an impact on the demand for money, the strength of its impact with establishing the effectiveness of monetary policy might arguably also rest on the level of financial sector development in Namibia. Therefore, based on the findings of this paper, the shortcomings highlighted with the first proxy used coupled with inadequate time series related to the "conduits of financial innovation" in the payments system, future research will benefit from testing micro-level proxies of financial innovation to build on what has been established thus far.

**Policy recommendations for monetary policy relate to both enhanced awareness and responsiveness of the monetary authority to the likely impact of financial innovation on key monitored monetary aggregates.** Considering Namibia's fixed exchange rate arrangement, much of its monetary policy discussions have been devoted towards developments in credit extension, inflation forecasts and the reserve adequacy. It is, however, still important for the monetary authority to review, have foresight and respond accordingly to the potential implications posed by financial innovation as economic and financial transactions become more complex in a digital global economy. While financial innovation is important for enhancing financial sector development, the findings of this paper echo those of Dabrowski (2017) which suggest that financial innovation is unlikely to cause revolutionary changes to the current conduct of monetary policy. This is and should be true if the demand for money, both reserve money to commercial banks and currency in circulation to the public persists.

**Financial innovation might, however, pose technical challenges to the conduct of monetary policy.** Dabrowski (2017) cites that while financial innovation leads to financial sector development, it might, however, present some technical challenges to monetary policy making. It follows that because financial innovation causes changes to financial; products, institutions, market structure and the processing of financial transactions, these changes may affect the monetary policy transmission mechanism and ultimately hamper the effectiveness of individual monetary policy instruments. Furthermore, the complexity posed by financial innovation via new financial products within monetary aggregates might necessitate revisions to broad money aggregates beyond M2. In this regard, policy makers will need to appropriately consider how definitions to monetary aggregates might vary with innovation, how strong and/or weak the monetary policy transmission mechanism might become, and the inherent possible future need to revise the monetary policy framework in line with the appropriate financial innovation developments.

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# 7. APPENDICES

## A. STYLISED FACTS

### A.1 The Namibia Financial Sector Strategy

A ten-year strategy covering the period 2011-2021 was developed to address the weaknesses in the Namibian financial system, which will enable the country's financial sector to transform and contribute meaningfully to the developmental objectives of the country. The strategy charts the future direction of the financial system over 10 years that will ensure its effectiveness, competitiveness and resilience.

More specifically, it is hoped that by the end of year 2021, the strategy should have achieved the following outcomes:

- *a deepened, an efficient and developed financial system;*
- *respected, world class and effective regulators;*
- *a stable, well-regulated and competitive financial sector;*
- *significant local ownership of financial institutions;*
- *an inclusive financial sector; and*
- *financially literate and protected consumers of financial services and products.*

The strategy therefore prides itself in achieving a well-developed and diversified financial sector which will be characterised by efficiency, effectiveness and stability, competitiveness, resilience and inclusiveness (Namibia Financial Sector Strategy).

### A.2 What does the financial sector strategy say about the level of innovation and weaknesses?

A review of Namibia's financial system shows that although the system is sound and well-functioning, there are structural weaknesses that need to be addressed to enable the financial sector to contribute meaningfully to the overall performance of the country's economy. Key weaknesses identified include: *a shallow financial market*; *limited competition*, *limited financial safety nets*, an *under-developed capital market*; *inadequate and less effective regulation*; *limited access to financial services*; *low financial literacy and lack of consumer protection*; *lack of*

*consumer activism, limited skills; and low participation by Namibians and thus dominance of foreign ownership.*

The strategy, however, does not dwell into key innovations in the financial sector but rather addresses the financial infrastructure in place via the National Payment System. All the innovations and trends are classified under the year in which they emerged.

## B. Innovations in the NPS over the last six years

| 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| **Launch of the First Commercial Bank Electronic Wallet** - The electronic wallet makes it possible to transfer money between two parties through the use of mobile devices. The value in wallets can also be used to purchase value added services such as airtime, electricity etc. | **Enhanced Electronic Funds Transfer system -** The modernisation of the current EFT system aims to improve the efficiency in the NPS, particularly around EFT payments by enhancing the speed of settlement and security.<br><br>**Cardless Cash Withdrawals -** The introduction of cardless cash withdrawals directly from your bank accounts.<br><br>**Smart Banking Application** - Introduction | **E-commerce** – The registration of the first payment solution in Namibia that offers direct debits to local Namibian bank accounts using Merchant Accounts.<br><br>**Local Money Transfer Service -** Introduction of a local remittance platform. The solution enables the sending and receiving of money at any Shoprite retail outlet across the country. | **Self Service Branch –** The introduction of 24-hour self-service terminals and kiosks for the transfer and depositing of funds. | **Reduction of Cheque Item Limit** –The reduction of the cheque item limit was an initiative adopted by the Namibian banking industry with the aim to phase out cheques as a payment instrument in Namibia. The initiative was introduced due to the high level of fraud and the high cost of operating the cheque stream.<br><br>**Enhancement on the Electronic Wallet Service –** The introduction of additional functionality | **The Automatic Deposit Taking (ADT) Machine -** ADT is the first of its kind and the new generation of advanced ATMs introduced locally. This ATM machine allows for real-time (instant availability) deposits to accounts of up to N$20 000 per transaction.<br><br>**Cash Back Reward System -** First of its kind rewards system was introduced where you |

| | | | | | |
|---|---|---|---|---|---|
| | of the first Smart Banking Application in Namibia. | | | like the payment of bills and services were added to the electronic wallet service. | can earn cash back every time you spend with your Debit or Credit card, purchase airtime, pay for your fuel purchases with your Credit Card.<br><br>**Smart Mobile Fuel Payment System in Namibia** - The Shell Fuel Card is a smart technology fuel payment option that gives fleet owners control over their fuel spent |

Source: Van Rooyen (2018)

## C. Conduits of Financial Innovation


Source: Bank of Namibia, Payments Systems Department

## D. Table 1: Unit Root Test at Levels and First Difference

| **Levels with intercepts** | | | **First difference with intercepts** | | **Order of correlation** |
|---|---|---|---|---|---|
| ***Variables*** | ***KPSS*** | ***PP*** | ***KPSS*** | ***PP*** | |
| **M1** | 1.117141* ** | 2.128910* ** (0.9999) | 0.162166 0.463000 | -8.735023 (0.0000) | I (1) |
| **M2** | 1.097700* ** | -1.192727* ** (0.6734) | - 0.130893 | -11.89016 (0.0001) | I (1) |
| **PSCE** | 0.949491* ** | -2.458874* ** (0.1299) | - 0.231483 | -10.83343 (0.0001) | I (1) |
| **GDP** | 1.098558* ** | -2.296414* ** (0.1760) | 0.453855 | -3.616696 (0.0078) | I (1) |
| **RS** | 0.845362* ** | - -2.344125* ** (0.1615) | 0.124041 | --7.482799 (0.0000) | I (1) |
| **Exr** | 0.827495* ** | -1.01068* ** (0.7454) | 0.211530 | -6.775180 0.0000 | I (1) |
| **Cpi** | 1.133269* ** | -1.344399* ** (0.6045) | 0.202386 | -5.581355 (0.0000) | I (1) |
| **Fin inv 1 Stock Mkt + DC/GDP** | 1.115525* ** | -0.631449* ** (0.8562) | 0.164093 | -8.033496 (0.0000) | I (1) |
| **Fin inv 2 (M2/M1)** | 0.552219* ** | -1.965191* ** (0.3014) | 0.082278 | 8.850968 (0.0000) | I (1) |
| **Fin inv 3 PSCE/GDP** | 1.101944* ** | 0.302132* ** (0.9186) | 0.078605 | -9.554665 (0.0000) | I (1) |
| **Fin inv 4 Bank Asset/GDP** | 1.135292* ** | -1.229359* ** (0.6574) | 0.192596 | -15.32104 (0.001) | I (1) |
| **Free float** | 1.122459 * ** | -1.026834 (0.7395) | 0.169210 | -10.57342 (0.0001) | I (1) |
| **Free float + PSCE/GDP** | 0.795855* ** | -0.828539 (0.8044) | 0.090946 | -9.180610 (0.0000) | I (1) |
| **Listed Bonds** | 1.084317* ** | -4.784595 (0.00002) | 0.167807 | -35.24042 (0.00001) | I (1) |
| **Listed Bonds +PSCE/GDP** | 1.033297* ** | -5.365170 (0.0000) | 0.169252 | -36.71250 (0.0001) | I (1) |

*Notes: * & ** denotes non-stationarity*

## D.1 Long run estimation of money demand function with financial innovation proxied by (stock market capitalisation[19] +domestic credit)/GDP

$$lnM2_t = -4.65 + 2.56lncpi_t + 0.32lny_t - 0.06tbn - 0.08dr + 0.08satb + 0.23lnNEER_t - 0.09fin \ldots . (6)$$
(0.2) (0.0) (0.2) (0.0) (0.0) (0.0) (0.5) (0.0)

### D.1.1 Table 4: Error correction model of equation 6

| Variable | Coefficient | t-Statistic | Prob. |
|---|---|---|---|
| D(LNGDP) | -0.440219 | -0.760440 | 0.4500 |
| D(LNER(-1)) | -0.655994 | -2.112676 | 0.0388 |
| D(LNCPI(-2)) | 1.502740 | 1.995879 | 0.0505 |
| D(SATB(-2)) | -0.034692 | -2.532196 | 0.0140 |
| D(TB(-2)) | 0.049240 | 3.488771 | 0.0009 |
| D(DR) | -0.058615 | -3.903119 | 0.0002 |
| D(FIN4(-1)) | -0.050955 | -0.969297 | 0.3363 |
| ECT4(-1) | -0.155424 | -1.977956 | 0.0525 |
| C | 0.015643 | 1.120096 | 0.2671 |
| $R^2$== 0.465808<br>Adjusted $R^2$= 0.394582 | | Durbin-Watson stat 2.247585 | |

## D.2 Long run estimation of money demand function with financial innovation (M2/M1)

$$lnM2_t = -6.37 + 1.58lncpi_t + 0.92lny_t - 0.07tbn - 0.04dr + 0.10satb + 0.04lnNEER_t + 0.39fin \ldots . (7)$$
(0.0) (0.0) (0.0) (0.0) (0.0) (0.0) (0.5) (0.0)

### D.2.1 Table 5: Error correction model of equation 7

| Variable | Coefficient | t-Statistic | Prob. |
|---|---|---|---|
| D(LNGDP(-2)) | 0.497269 | 0.953265 | 0.3443 |
| D(LNER(-1)) | -0.551223 | -1.965051 | 0.0540 |
| D(LNCPI(-2)) | 1.231426 | 1.725271 | 0.0896 |
| D(TB(-2)) | 0.041587 | 3.145641 | 0.0026 |

[19] The local NSX market capitalisation data was used.

| | | | |
|---|---|---|---|
| D(DR) | -0.048693 | -3.490317 | 0.0009 |
| D(SATB(-2)) | -0.022057 | -1.796598 | 0.0774 |
| D(FININV) | 0.183007 | 3.422251 | 0.0011 |
| ECM(-1) | -0.281365 | -3.009199 | 0.0038 |
| C | 0.006717 | 0.512545 | 0.6102 |
| *R-squared 0.546501* | *Adjusted R-squared 0.486035* | *Durbin-Watson stat 2.122344* | |

### D.3 Long run estimation of money demand function with financial innovation (Private domestic credit/GDP)

$$lnM2_t = -3.89 + 2.38lncpi_t + 0.29lny_t + 0.10satb - 0.08tb - 0.09dr + 0.32lnNEER_t - 0.06fin_t \ldots . (8)$$
(0.29) (0.0) (0.30) (0.0) (0.0) (0.0) (0.35) (0.27)

### D.3.1 Table 6: Error correction model of equation 8

| **Variable** | **Coefficient** | **t-Statistic** | **Prob.** |
|---|---|---|---|
| D(LNGDP) | -0.450853 | -0.784921 | 0.4356 |
| D(LNER(-1)) | -0.665346 | -2.172713 | 0.0338 |
| D(LNCPI(-2)) | 1.572458 | 2.099754 | 0.0400 |
| D(SATB(-2)) | -0.036157 | -2.608462 | 0.0115 |
| D(TB(-2)) | 0.049015 | 3.492571 | 0.0009 |
| D(DR) | -0.060461 | -3.965738 | 0.0002 |
| D(FIN3(-1)) | -0.069507 | -1.238551 | 0.2203 |
| ECM(-1) | -0.159376 | -2.083451 | 0.0415 |
| C | 0.014885 | 1.081966 | 0.2836 |
| R-squared 0.471611 | Adjusted R squared 0.401159 | Durbin-Watson stat | 2.242764 |

## D.4 Long run[20] estimation of money demand function with financial innovation (bank assets[21]/GDP)

$$lnM2_t = -1.69 + 2.09lncpi_t + 0.16lny_t - 0.08tbn - 0.11dr + 0.11satb + 0.22lnNEER_t + 0.10fin \ldots . (9)$$
(0.6) (0.0) (0.5) (0.0) (0.0) (0.0) (0.5) (0.7)

**Figure 2: Cusum and Cusum square plot for money demand function- with financial innovation, (Stock market capitalisation +Domestic Credit /GDP).**

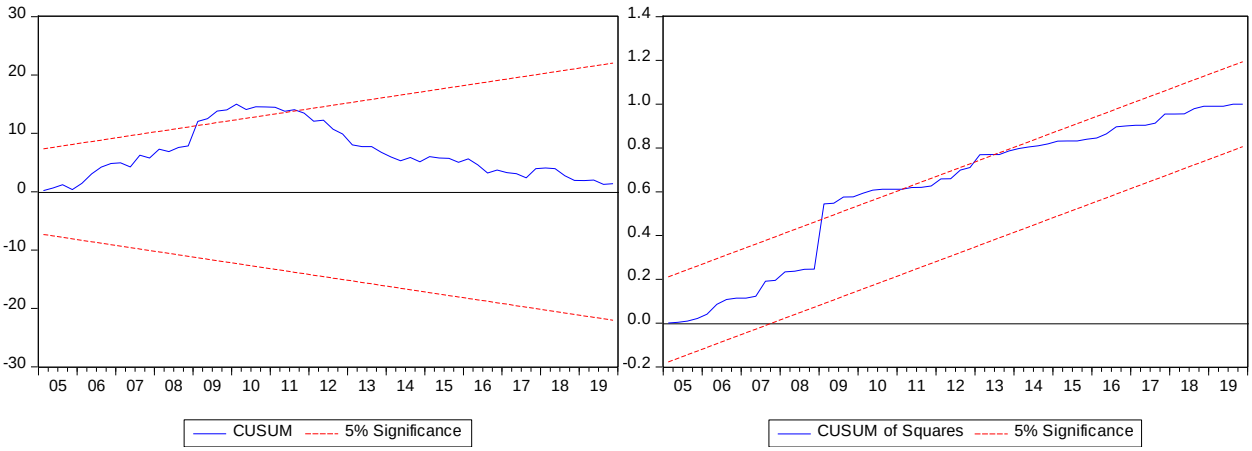
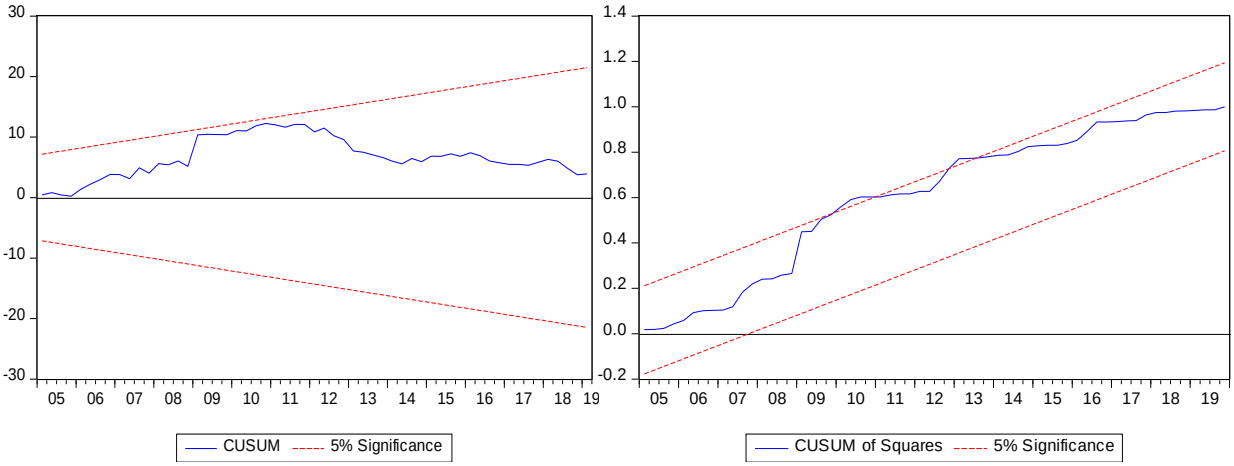



**Figure 3: Cusum and Cusum square plot for money demand function- with financial innovation, M2/M1.**




[20] See Table 3 in text
[21] Commercial Bank Assets

**Figure 4: Cusum and Cusum square plot for money demand function- with financial innovation PSCE/GDP.**

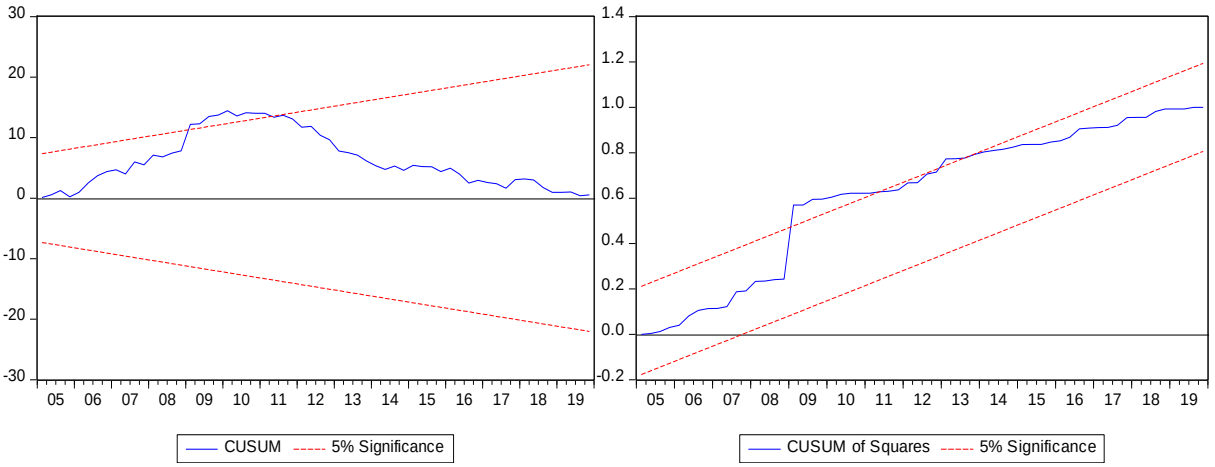



**Figure 5: Cusum and Cusum square plot for money demand function - with financial innovation, Bank Assets/GDP.**