THE NEXUS BETWEEN FINANCIAL INNOVATIONS AND VELOCITY OF MONEY: EVIDENCE FROM NAMIBIA

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ABSTRACT

The study of the velocity for money in an economy is a central issue in central bank policy formulation. This is so because a steady demand for money function is vital for the conduct of effective monetary policy. The study investigated the relationship between financial innovations and the velocity of money in the Namibian economy. Secondary data from the World Bank and Bank of Namibia, covering the period 2000 to 2020. The study relied on the Autoregressive Distributed Lag Model technique to test the relationship. The founding objectives were named to explore whether financial innovation explained the velocity of money and secondly whether there existed a short-run or a long-run relationship between the selected variables. The results indicate that financial innovations explain the velocity of money in the economy, and the Error Correction model determined that there was an existent long-run relationship between the variables. The margin of the inverse relationship was evident from the coefficient of -1.107354, meaning that an increase by one unit change in financial innovation caused a -1.107354 decrease in the velocity of money in the economy. Hence, the study found that both in the short-run and long-run financial sector innovations are inseparably linked with the velocity of money. The model also included two control variables GDP and the opportunity cost of holding money as the theoretical foundation nominate the two variables to also affect money demand which eventually affects velocity of money. The results found that a positive relationship existed between the GDP variable and velocity of money and the magnitude effect of the relationship is shown by the coefficient. The other variable opportunity cost of holding money was found to be statistically insignificant as showed the probability and the t-statistic. From these results, a cautionary advice would be extended to the policymakers to manage this dynamic relationships better as it has a bearing on the monetary policy framework in the case of the velocity of money (money demand function) in an economy.

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ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akaike information criterion
ARDL	Auto Regressive Distributed Lag
BoN	Bank of Namibia
CPI	Consumer Price Index
DW	Durbin Watson Statistic
ECM	Error Correction Model
FNB	First National Bank
GDP	Gross Domestic Product
IMF	International Monetary Fund
NPS	National Payment System
NSA	Namibia Statistics Agency
NSX	Namibia Stock Exchange
PoS	Point of Sale

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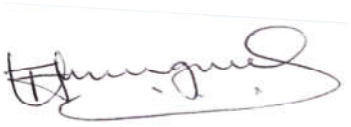
DEDICATION

This piece of work is dedicated to my father, the late Absalom Kasamane Uugulu for his academic outstanding in the field of art (Library and Information) in both Zambia and Namibia between 1980 and 2003.

DECLARATION

I, Tomas Mekondjo Uugulu, hereby declare that this study is my own work and is a true reflection of my research and that this work or any part thereof, has not been submitted for a degree at any other institution.

Tomas M Uugulu



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Signature

CHAPTER 1

1. INTRODUCTION

1.1. Background of the study

The study on the link between velocity of money in an economy and levels of financial innovation has gained traction in recent years. Financial innovation can be defined as technological advances which facilitate access to information, trading as a means of payment, the emergence of new financial instruments and services, and more developed and complete financial markets (Lando & Manuel, 2020). On the other hand, the velocity of money, also called velocity of circulation, is the average rate of recurrence with which a unit of money is spent on new goods and services produced (Ndlovu, 2013).

In the last ten years, the Namibian financial sector experienced many innovations intended to improve the proficiency with which banks and their clients transact. Many of the innovations were adopted by most banks over in the form of e-wallet services with Automated Teller Machines (ATMs) preferred to card-less cash withdrawals (Van Rooyen, 2018). The effects of the financial innovation in banking and financial markets on the velocity of circulation in Namibia has not been explored, given the lack of literature on the subject (Lando & Manuel, 2020). This study will empirically test the relationship between financial innovation and velocity of money from the year 2000 to 2020, which witnessed significant changes in the structure of the financial sector

(institutions, instruments and markets) and resultant changes in money velocity in Namibia (Lando & Manuel, 2020).

1.1.1 Namibian financial structure overview

Ahmad (2015) examined Namibia's financial sector and found that the country's financial system was still emerging, although at a rapid pace compared to other African countries, particularly those in Sub-Saharan Africa. According to Ahmad (2015), The Namibian financial systems are a dual system that includes both the official and informal sectors. Bank of Namibia, Commercial Banks, National Housing Enterprise, Agricultural Bank of Namibia, Development Bank of Namibia, Pension Funds, Savings Banks, Insurance Companies, Namibia Stock Exchange (NSX), the Post Office, and Unit Trusts make up the formal sector. In contrast, microlenders make up the informal sector. For the context of this research, it is critical to investigate the function of major financial institutions, particularly Commercial Banks, because they play the utmost significant role in the country's degree of financial innovation.

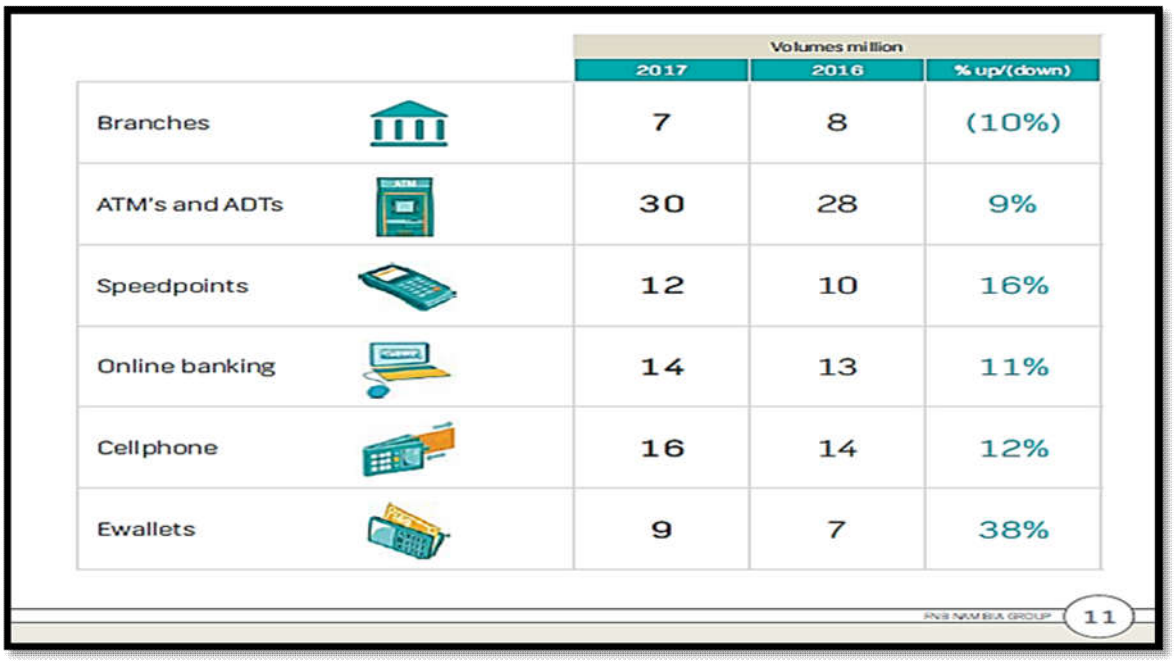
1.1.2 Financial innovation in Namibian commercial banks

Even though Namibia has a variety of banking organisations, the country only has five licensed commercial banks: The First National Bank (FNB), Standard Bank, Bank Windhoek, Bank BIC Namibia Limited, and Nedbank Namibia (BON, 2011). According to Ikhide (2000), commercial banks dominate Namibia's financial system, with the bulk of banks located in cities and regions with more industries and higher per capita income. South Africans partly own almost all Namibian banks; for example, 100% of Standard Bank shares are held by South Africans, South Africans own 78 percent of FNB shares, and 43.6 percent of Bank Windhoek shares are owned by South Africans (Ahmad,

2015). The explanation for this might be that there are no barriers to access the Namibian financial industry, despite the fact that large capital is required for the establishment, which appears to be a barrier to entry. Commercial banks provide various services, including receiving deposits from savers and utilising the money to provide loans to individuals in need. They also manage to provide interest rates to savers and charge interest to borrowers. Bank charges, on the other hand, generate greater profit.

At all commercial banks, the interaction of technology, data, and consumers is disrupting traditional banking and transactional processes. Innovative players use new finance platforms, open banking, and cloud-based goods and services to provide flexible and dynamic solutions. Commercial banks have accomplished this through strategic efforts that focus on changing current organizations and exploring new digital growth prospects and have implemented a variety of projects in e-commerce, distribution, payments solutions, digital banking, and biometrics throughout time. This has driven the migration of customers to digital banking facilities. A good example of this can be noted from two selected examples chosen from the FNB Annual Report 2017/2018 (Figure 1 below).

Figure 1: How clients at First National Bank Namibia Transact using the newly introduced financial innovations



	Volumes million		
	2017	2016	% up/(down)
Branches	7	8	(10%)
ATM's and ADTs	30	28	9%
Speedpoints	12	10	16%
Online banking	14	13	11%
Cellphone	16	14	12%
Ewallets	9	7	38%

Source: FNB Annual Report 2017/18

The above extract from the FNB annual report shown in Figure 1 clearly indicates that 90% of transactions done utilise the newly introduced financial innovations whilst only 10% still utilise the traditional banking methods. The breakdown of the financial innovations used is made up of ATMs and ADTs with 9% usage, then Speed points with 16%, also online banking with 11%, cellphone banking 12% and e-wallets dominating with an enormous 38% usage.

To show the extent of the usage of the new financial innovations, it was necessary to study at another bank hence below, Figure 2 below indicates an extract from Capricorn Holdings Annual Report, Capricorn owns Bank Windhoek.

Figure 2: The Digital Migration Indicator at Bank Windhoek for 2018, 2019 and 2020

Digital migration indicator	2020	2019	2018
% growth in mobile app use	46.0	58.1	58.3
% growth in iBank use	(8.8)	(1.5)	5.4
% growth in cellphone banking	25.1	23.8	24.1
% growth in point-of-sales	(3.4)	5.4	(4.8)

Source: Bank Windhoek (2020).

The figures presented in Figure 2 indicate that clearly there has been a steady migration to the use of more modern ways to transact as opposed to the traditional means with year-on-year growth in percentage volumes in mobile application use, iBank use, cellphone banking and the use of point of sales.

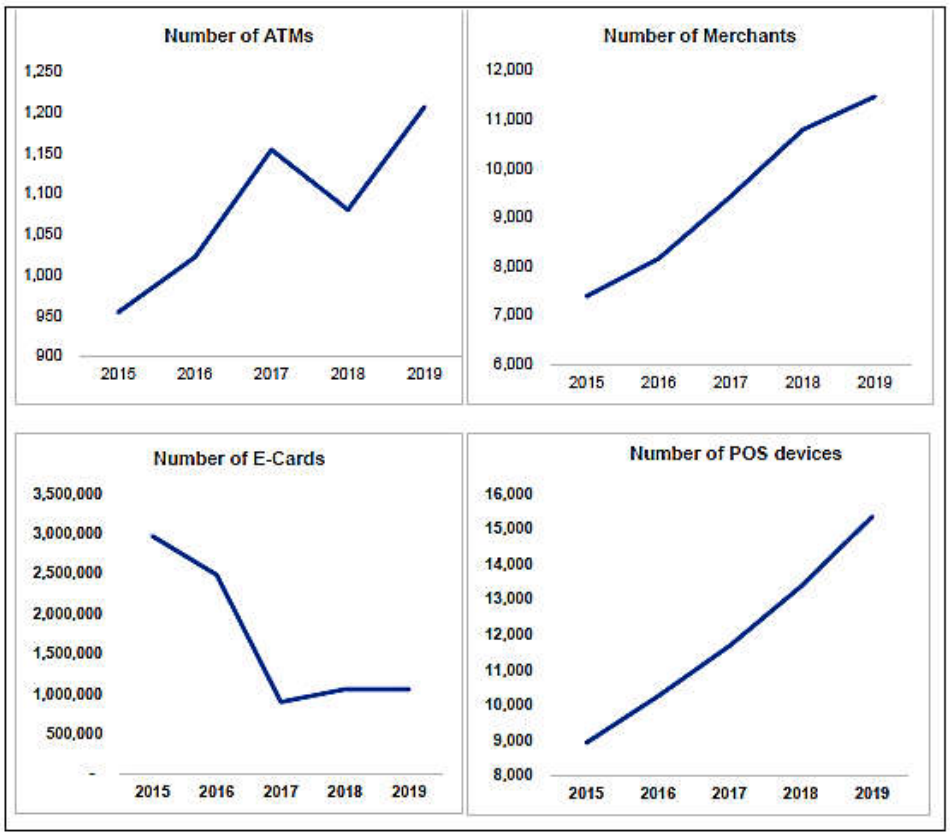
1.1.3 Financial Innovations in the Namibian National Payment System

Financial innovations in the Namibian banking system can be analysed together with key developments in Namibia's National Payments System, which often work in accordance with those innovations in the banking sector. Moreover, The National Payments System has experienced an advancement since its establishment in 2002, with several payment system modifications employed. 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 from 2012 to 2017 were largely consistent with observable global trends. These included a move 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). Figure 3 below highlights the innovations and trends in the NPS over the last six years.

Figure 3: Highlights of the Financial Innovation Trends as observed by BoN Payments Systems Department

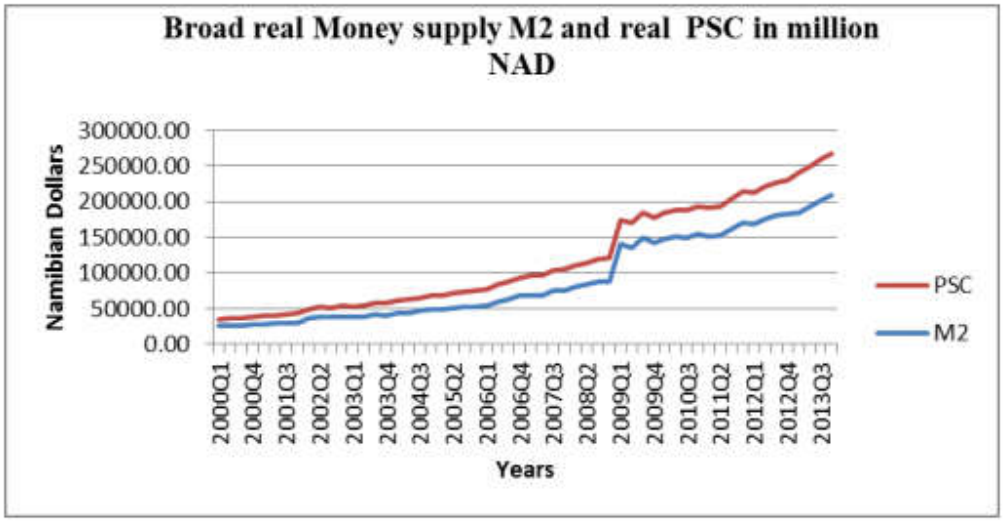


Source: BoN, Payments Systems Department (2020)

Since independence, Namibia's money velocity has been continuously decreasing, owing to the country's increasing commercialization. The severe drop in M1 velocity relative to quasi-money and broad money indicates M1's rapid growth rates in relation to income over the time under consideration. The severe drop in money velocity has partially countered the inflationary potential of the money supply expansion. However, credit granted to the private sector is employed as a proxy for financial innovation in the

current study. From 2000: Q1 to 2013:Q4.3, Figure 4, depicts the trend of credit given to the private sector and M2 aggregates in Namibia.

Figure 4: Trend of M2 and PSC from 2000:Q1-2013:Q4



Data Source: Bank of Namibia Quarterly reports (2000-2013)

Both M2 and private sector credit aggregates have been increasing upwards over the past 13 years, as observed in Figure 4. The graph illustrates that the two variables have both a positive and a negative association. In 2009, however, both variables increased. This could be attributed to the Bank of Namibia's expansionary monetary policy, which was implemented in 2009 to mitigate the negative impacts of global economic crises (Ministry of Finance, 2011). The goal of the policy was to boost both domestic consumption and business investment. The study's goal is to investigate the impact of financial innovation on Namibia's money velocity.

1.2 Statement of the problem

Today, 90% of financial products are accessed by means of numerous electronic resources, namely ATMs, internet and mobile phones, etc., which has fairly altered the velocity of circulation in Namibia (Van Rooyen, 2018). The introductions of these new products have placed pressure on monetary policy formulation by the Bank of Namibia and other financial regulatory agencies like Namibia Financial Institutions Supervisory Authority (Lando & Manuel, 2020). Financial innovation, although desirable nonetheless, also tends to create instability in the money demand and credit aggregates in an economy. Financial innovation established new innovative products, and this has a tendency of confounding the division concerning 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 destabilize the demand for money and hence affect money velocity (Solans, 2003). Hence, close monitoring of the developments in the financial sector is imperative as they may have significant implications for the economy. Primarily, innovations 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, financial innovation could necessitate new regulations, which might, in turn, compromise the effectiveness of the monetary policy (Misati et al., 2010). However, far too little attention has been paid to this area of research in Namibia. Many researchers have concentrated on the relationship between financial development and economic growth, and less is known about the relationship between financial innovation and the velocity of money in Namibia. Several theoretical and empirical studies have

analysed the relationship between the financial sector and economic growth indicators examples are Sunde`s (2009) and Sylvia Kinyondo's (2018) studies. Hence, a further insight on the subject matter is vital to Namibia to influence future policy framework from the empirical findings and thereof accord necessary recommendations. The study thus attempts to investigate the implication of this relationship between financial innovations and the velocity of money in Namibia and bridge the literature gap on the subject.

1.3 Objectives of the study

The primary research objective of this study was to:

Assess the relationship between financial innovations and velocity of money in Namibia.

The secondary objectives derived from this primary objective are:

1.3.1 To explore whether financial innovation explains the velocity of money in Namibia.

1.3.2 To analyse whether there is a long run relationship between financial innovations and velocity of money.

1.4 Hypotheses of the study

H_1: There is no relationship between financial innovations and velocity of money.

H_0: There is a relationship between financial innovations and velocity of money.

1.5 Significance of the study

The major aim of the study is to bridge the gap that previous studies left. The study would contribute to the economic knowledge on the relationship between financial innovations and circulation velocity, which is an important aspect of the central bank monetary policy formulation. The study will provide recommendations to policymakers and can be used for future research as it contributes to the existing literature. The main beneficiaries of the study are policymakers and academia. Policymakers have to address macroeconomic issues through favourable policies, while academia would appreciate an increase in the volume of knowledge in the specific study area.

1.6 Limitation of the study

Guetterman (2015), defined study limitations as factors that exist outside the researcher's scope, and these become potential flaws in a study. During the compilation of this research, quite a number of challenges were faced. Neglecting these challenges would limit the precision of the estimated parameters and consequently reduce the reliability and validity of the results—the major challenge related to the specification of the model. The required data on some of the variables of the model was limited, considering the span of the research period. The major challenge relates to the availability of financial data to run the regression. The required data on some of the model variables is limited, considering the span of the research period. This was mitigated by gathering data from many sources and not limited to one source, hence data was collected from BON, Namibia Statistics Agency (NSA), as well as international sources such as the International Monetary Fund (IMF) and the World Bank (Apere, 2017).

More so, to avoid false regression, variables were tested for stationarity, and non-stationary data was made stationary using the differencing method, forfeiting degrees of freedom. However, to control that, the STATA econometric software was chosen to analyse the time-series data. According to Baum (2006), STATA statistical software has a strong ability to analyse time-series data using time series Autoregressive Distributed Lag (ARDL) Model, which has the advantage of allowing the variables that are integrated at zero and one to be analysed (Pesaran & Shin, 1999) and also the fact that the test is considered to be more efficient in small data samples, which are characteristic of developing countries like Namibia.

1.7 Delimitation of the study

This study provides an analysis of the impact of innovation in the financial sector on velocity of circulation in Namibia from 2010 to 2020. The chosen timeline is sufficient to provide a realistic investigation into the underlying phenomenon as it will sufficiently cover the period that has experienced the rise in financial innovation in Namibia (Van Rooyen, 2018).

1.8 Outline of the Study

Chapter one introduced the whole research project and carries the summary of the problem which gives the researcher need to carry out a research on the link that exist between financial innovations and the velocity of circulation It is followed by chapter two (literature view) which shows the theoretical and the empirical view of the research project. This gives an outline of how the theory suggested by different scholars says about the variables in question financial innovations as well as velocity of money in the

Namibian economy. The empirical view shows the practical previous performances in other countries the world over.

Chapter two is followed by chapter three (research methodology) which shows the model specification, justification of variables and regression analysis of the variables which are used in the research project. After the methodology, then comes the chapter four (results presentation and discussion) which shows what is presented and how to deal with the data. Lastly is the chapter five that gives recommendations on policies which could be implemented.

1.1 1.9 Summary

This chapter focused on the introduction, background of the study, statement of the problem, the purpose of the study, and the significance of the study. In addition, it introduced the research and explored the subject matter. Moreover, it explained the rationale behind the research and what motivated the study. The next chapter provides insight into the literature foundations of the study.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Introduction

The chapter will analyse and evaluate the existing theories and empirical studies that have been undertaken on financial innovation and the velocity of money across the world. A thorough review of these works will facilitate and guide the study on how financial innovations affect the velocity of circulation in Namibia.

2.2 Theoretical Literature

2.2.1 Traditional Theories of Demand for Money

There is 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 the nominal income of the economy. It further extrapolates 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 emphasize the importance of interest rates in determining the demand for money and advocate that individual hold money for the transaction, precautionary and speculative motives. 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.

2.2.2 Traditional perspectives on demand for money: similarities and differences:

The traditional theory of the demand for money function emphasized that money is desired as a medium of commerce and a store of wealth; however, the interest rate is not included in their formulation of the demand for money function. On the other hand, Keynes concurred with the Classical Cambridge economist that money may be used as a store of value, emphasizing the importance of the interest rate as a determining factor in how much wealth should be held.

Tobin and Baumol extend Keynes' theory of money demand. They contended that, due to uncertainty, individuals and businesses should have either money or bonds at the same time, contrary to Keynes' assertion that they can hold both. People switch between money and interest income gained from owning bonds, according to Baumol and Tobin. Furthermore, Friedman emphasizes that, unlike Keynes, the demand for money is a function of overall wealth as well as income and interest rates.

Income was a crucial driver for the demand for money function, according to Friedman, Keynes, Tobin, and Baumol. McKinnon and Shaw (1973) hold a similar viewpoint. McKinnon and Shaw (1973), on the other hand, support the level of investment on capital returns, stating that an individual must first amass savings before investing. As a result, the actual deposit rate of interest is one of the variables in their demand for money function definition.

The Cambridge School, Keynes, Friedman, Tobin and Baumol, McKinnon, and Shaw all emphasize income as a crucial element in their ideas on demand for money specification in demand for money specification matrix.

2.2.3 Financial Innovations and the Demand for Money

According to Apere (2017), the growth in financial innovation has the potential to enhance efficiency in an economy but can pose instability in demand for money. Historically, to achieve the ultimate goal of price stability, central banks required a stable money demand function or understanding of the causes of the instability, as was the case with regard to the European Central Bank discussed earlier. Most central banks now work with a framework to 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 how 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 & 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 study 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.

2.3 Empirical Literature

The demand for money is important in the conduct and determination of the effectiveness of the 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. In contrast, 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) implemented 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 the instability of the two variables. The study estimated impulse response functions in two separate samples. Results revealed 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 the 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 co-integration and error correction methodology using quarterly data from 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 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 from 2000Q1 to 2012Q4. The study found no long run relationship over that period among the variables. In this regard, as the mentioned authors already tested the money demand function, 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.

Darrat (1988) has studied the historical behaviour of velocity of money in Tunisia under the Islamic interest-free banking system. Explaining the differences between the Islamic banking system and the contemporary system with the main purpose of empirically testing the hypothesis that the financial system becomes more stable without interest-bearing assets. His paper focuses on Tunisia as the case study with cross-section data from 1960-1984. In this study, he explains and investigates the historical behaviour of velocity of money in Tunisia, and states: "…study of historical movements of velocity in Tunisia over the estimation period indicates that the velocity of interest-bearing money stock (VMI) has undergone a dramatic change over the years…the behaviour of non-

interest velocity of money (VMNI) appears to have been smooth stable. Indeed, for all practical purposes, VMNI appears to be almost a constant." (Darrat, 1988). He concluded that: "In contrast to the interest-based system, an interest-free monetary system is found to exhibit a well-behaving and smooth velocity of money." (Darrat, 1988).

The study of Maysami and Nie (1999) focuses on historical records of interest and non-interest velocity of money in Iran, Pakistan and Sudan from 1966 to 1994 for thirty years. Where Pakistan and Sudan show similar patterns on -bearing interest money is greater than that of interest-free money. Velocity of interest-free money in Pakistan and Sudan, which stand at 8.14 and 3.90 respectively, are much more stable as compared to velocity of interest-bearing money that stands at 15.82 and 18.72. The results of the study indicate that the removal of interest may lead to better implementation of monetary policies.

Hind (2003), in her study that identified the factors which determine the velocity of money in Sudan in the period (1970-2000); the study used analytical and statistical approaches to estimate velocity of money as a function of national income, per-capita income, inflation rate, money balance, currency ratio outside the banking system and the number of commercial banks branches. The study reveals that 98% of the total changes in velocity of money were explained by the explanatory variables. Also, there is a positive relationship between the explanatory variables, where there is a negative relationship between the dependent and the real money balance variable. The policy implication indicated that the expansionary policies, which aimed at increasing the National income, such policies at the end, will lead to inflation. Whereas the policies

which increase bank infrastructure have a positive effect increasing the credit feelings, and so decreasing the use of money as a means of payment which will lead to decreased use of money outside the bank system.

Abdul Karim et al. (2010) examined the volatility of money velocity function in Malaysia by using the quarterly time-series data. Their study employed the recent econometric techniques such as volatility model in ARCH and GARCH framework, Johansen cointegration test and Vector Error Correction Model (VECM). The results indicated that the velocity of money for M1 (V1) and M2 (V2) are volatile and persistence rather than M3 (V3). The Johansen co-integration test result indicates the existence of long run relationship between velocity of money V1, V2 and V3 on the dependent variables, such as bond interest rate, deposit rate and income. Furthermore, the VECM result illustrates that the changes independent variables such as bond interest rate, deposit rate and income are significantly influence the changes in velocity of money for V2 and V3 in the long run. Conversely, in the short run, a change in the national income has only significantly caused the changes in the velocity of money V2 and V3, while the interest rate has significant effect to cause the velocity of money V3.

Meanwhile, Gill (2010) uses co-integration techniques to identify the determinants of income velocity of money (VM) in Pakistan. The analysis covers narrow money (M2). The co-integration results support a positive relationship of VM with economic growth, indicating an increasing VM over time in the time of high growth in Pakistan. Financial development, as measured by its proxies and prices as measured by CPI, affects VM positively. So, having an increasing VM with these variables, the potential adverse impact of expansionary monetary policy is not likely to be small in Pakistan. On the

other hand, interest rate also has a positive impact on VM. The results indicate that it is important for the monetary authorities to consider both economic and financial development stages in forecasting VM for designing effective monetary policy in Pakistan.

Mustafa (2010) empirically studied and estimated the behavioural explanation of income velocity of money function in the case of Sudan over the period 1985 to 2004. A simple monetary model was formulated to serve the purpose, and the study chose the gross domestic product money supply; and rate of return under interest-free Islamic banking as a substitute to the rate of interest, which is prohibited, also we add banks offices and inflation were added, the behaviour of velocity of narrow money (V1) was unstable with average of 8.72 and always higher than velocity of broad money (V2) which stands at 5.8 and seems to be more stable and predictable. From this analysis, it is clear that the income velocity of the broad money stock is declining faster and more steadily falling than that of the income velocity of narrow money; surprisingly, the empirical evidence is significant.

Akinlo (2012) investigates the impact of financial development on the velocity of money in Nigeria from 1986 to 2010. His study confirms the existence of a unique and statistically significant relationship between velocity of money and measures of financial development. The error-correction results indicate that the current exchange rate has a statistically significant negative effect on velocity of money in Nigeria. Per capita income has statistically significant relation with velocity of money, which supports the quantity theory. The results reveal that money issuing authorities cannot obtain additional leverage by issuing more money without generating high inflationary

pressure. The results also indicate the importance of financial sector innovations for velocity.

Using co-integration and error correction modelling, Mannah-Blankson and Belnye (2004) investigate the influence of financial innovation emerging from Ghana's Financial Sector Adjustment Program (FINSAP) on money demand. The study's findings reveal that income, inflation, currency rate, and 29 financial innovations all affect the long-term demand for real money balances in Ghana, with financial innovation having a positive impact on money demand in the long run.

Using monthly data from 1997 to 2005 and the Vector error correction model, Bilyk (2006) examined and evaluated the relationship between financial innovations and money demand in Ukraine (VECM). The findings demonstrate the importance of financial innovations in both narrow and broad money (M1 and M2). According to the impulse-response study, the influence of financial innovations is larger in the limited demand for money specifications. Furthermore, the study reveals that financial innovations have a long-term positive influence on money demand in Ukraine but a short-term negative impact.

Using annual data from 1978 to 2008 in Uganda, Maniragaba (2011) investigated the effects of financial liberalization on money demand and economic growth. The study focuses on financial sector reforms in Uganda as a result of financial liberalization measures such as interest rate deregulation, direct credit reduction, prudential rules implementation, privatization of state-owned banks, entry requirements reduction, securities market liberalization, and international financial liberalization. Using the error

correction method, the researchers discovered that financial liberalization had a favourable long-run influence on Uganda's money demand.

Using the Engle and Granger Two-Step Cointegration technique, Odularu and Okunrinboye (2009) evaluated the influence of financial innovation on money demand in Nigeria. The findings demonstrate that financial innovations in Nigeria have had little impact on money demand.

Using a vector autoregressive model, Godslove (2011) investigated interest rates and credit demand in Ghana from 1970 to 2007. According to the report, repressive high-interest rates in Ghana in the 1980s hampered effective financial intermediation. Even while interest rates have been high since 2000, they have been lower than in past decades. The findings reveal that interest rates have a beneficial short-term influence on domestic loans but a negative long-term one. He finds that, while rises in the real lending rate may not immediately stifle credit demand, they may eventually lead to a reduction in credit demand in the long run.

Based on the above literature, it can be concluded that there are some studies about velocity of money in developing countries. However, no in-depth study has ever been done in the area of financial innovation and velocity of money in Namibia probably because of a lack of sufficient information.

2.4 Knowledge Gap

The studies concerning the impact of financial innovations in an economy and its impact on the velocity of money in an economy, which further affects the money demand function and ultimately the monetary policy framework in Namibia, has not been well

debated for many years, evidenced by the inadequacy of studies done on the subject. The studies done concentrated mostly on the effects of financial innovations on economic growth, as evidenced by studies by Sunde (2009) and the likes of (Kinyondo 2018). To date, there is a huge vacuum on the study and the general implications to the functioning of the Namibian economy. Hence data unavailability and the fact that previous studies have omitted the concentration on velocity of money or lacked the depth in analyzing the relationship between financial innovation and velocity of money in Namibia. Additionally, the study covers a stretched period which covers the significant changes in both variables, the lengthy period of 20 years under research is likely to give accurate results.

2.5 Summary

The theoretical and empirical literature analysed provided a sound basis for both a negative or positive relationship between financial innovation and the velocity of money in Namibia. The chapter presented the literature pillars of this research study as well as exposed the knowledge gap that exists. This chapter expedited the study in electing the right methodology in data analysis and the variables to be chosen in order to attain the study's objectives. The next chapter presents the study methodology.

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1. Introduction

Through a thorough evaluation of the empirical literature, the researcher produced a methodology that will help explain the relationship between financial innovation and velocity of money in Namibia.

3.2. Research Design

Statistical and operational aspects were relied on in order to attain the study objectives and answer the research questions. The study will rely on non-linear, time series regression analysis in an attempt to explain movements in the financial innovations' variable by reference to movements in velocity of circulation (Wimmer & Dominick, 2000). There are different types of research design strategies that a researcher can adopt, which include sampling design, observational design, statistical design and operational design (Yin, 2003). For this study, statistical and operational aspects were relied on in order to attain the study objectives and answer the research questions.

3.3. Quantitative Approaches

This study relied on quantitative approaches. According to Saunders, Lewis and Thornhill (2007), Quantitative research deals with data collection techniques that generate or use numerical data. Qualitative research is premised on complete and detailed descriptions of events, whilst quantitative research requires the creation of statistical models to explain events (Jones, 2016). This study relied on quantitative approaches to empirically examine the relationship between financial innovations and

the velocity of money in Namibia, as evidenced from 2000 to 2020. This research study used the quantitative approach owing to the nature, scope, and type of data, research questions, and hypothesis to be tested. To investigate how much, how many, how often, to what extent numerical data was collected from the IMF, BoN and the World Bank data site, these are credible sources and most preferred for reliability of results in policy conclusions. The numerical data were then analysed using appropriate mathematically or statistically based methods, namely STATA. The approach assisted in obtaining the truth, in understanding the world well enough so that predictions can be made and controlled through identifying cause and effect relationships (Jones, 2016). However, the only disadvantage of quantitative research is that it fails to study phenomena in a natural setting for different people as qualitative research does.

3.4. Presentations and Analysis Procedures

According to Shamoo and Resnik (2003), several logical techniques deliver consistent inferences from the given data and differentiate the signal from the noise present in the data. Data analysis for this study is presented in the form of tables, graphs and statistical calculations. Additionally, according to Mouton (1996), the study also relies on descriptive and explanatory approaches as they are crucial in analysing typical data sets chosen for this study. It is also important to note that data analysis is perhaps the most critical component of this research or any other in general.

3.5. Theoretical Framework

The methodology used is from the modern quantity theory approach by (Friedman, 1959). This theory is used because it is consistent with Keynesian and Cambridge versions of money demand and also includes other factors in assessment of the income velocity function. This study therefore combines the classical economists' theory with Friedman's demand for money specification.

$$V = \frac{P \, x \, Y}{Ms} \quad \text{..... (1)}$$

Where; Ms = V (m_1+ m_2)

(P x Y) = Output (GDP)

Therefore: $$V = \frac{GDP}{Vm1 + Vm2} \quad \text{..... (2)}$$

With Equilibrium needing to satisfy Ms = Md..... (3)

$$Md = \int (OC, SC, T) \quad \text{..... (4)}$$

The final derived equation for velocity can be represented as:

Thus; $$Vm = \int (OC, SC, T) \quad \text{..... (5)}$$

Where Vm = Vm denotes the Velocity money. The money balances are a function of scale variable (sc), which represent economic activity, (oc) is the opportunity cost of holding the money and (T) is the technological innovations.

The scale variable (SC) is proxied by the real (GDP)/ income, the elements of vector of opportunity cost of holding money (OC) is proxied by the interest rate, exchange rate and inflation rate. The technological advancements (T) is proxied by financial innovations (FV).

3.5.1 Econometric Model

To examine the effects of financial innovation on the velocity of money the study will use equation (5) for Namibia. The econometric model is formulated from the equation (5) as follows;

$$\text{Ln}\,(Vm)\,t = \alpha 0 + \alpha 1 \text{Ln}\,(\text{GDP})\,t + \alpha 2(\text{OC})\,t + \alpha 3\,\text{Ln}\,(\text{FV})\,t + \varepsilon t \ldots\ldots\ldots\ldots\ldots (6)$$

All variables are in logarithms except the OC represented by interest rate, exchange rate and the inflation rate. According to Ericsson (1998) the interest rates can enter in either logs or levels. In the equation (6), interest rate, exchange rate and inflation rate variables are not in logarithms as this result in a semi-log demand for money specification. As a result, the coefficients on the interest rates are not elasticities. The error term is assumed to be white noise and α's are the parameter estimates.

3.6 Discussion and Justification of Variables

The study will augment the dependent variable V to velocity of narrow money (Vm1) and velocity of broad money (Vm2). The velocity of money was calculated by dividing the money supply (m1 & m2) by the economy's Gross Domestic (GDP). Independent variable (Fv) will be a combination of non-monetary variables that are main channels of financial innovation in the banking sector: Number of ATMs, Number of Merchants, Number of Electronic cards and Number of Point-of-Sale devices from the year 2000 to 2020. The growth of financial innovations, especially the banking system, is reflected more accurately using banking the above financial innovations mainly used or linked by banks. (Ma & Lin, 2016).

3.6.1 Velocity of Money (V)

The dependent variable Vm1 + Vm2, representing the two measures of velocity namely: velocity of narrow money (Vm1) and velocity of broad money (Vm2). Velocity of money was calculated by dividing the money supply (m1 & m2) by the economy's Gross Domestic (GDP). The selected variable was selected since they fully represent the money demand function in Namibia.

3.6.2 Opportunity cost of Holding Money (OC)

The OC represented is by the summation of interest rate, exchange rate and the inflation rate from the year 2000 to 2020. OC is included in the model as a control variable to balance the model.

(a) The **Inflation Rate** will be taken as Inflation in consumer prices (annual %). Inflation is a rise in the price level, when inflation rises, economic agents reduce holding

money balances in favour of real assets. Hence, the real value of money falls with an increase in inflation. The value of assets is maintained, these leads to economic agents switching out of money to real assets when the inflation is expected to rise (Mwangi, 2014). Hence, the expected sign is negative.

(b) The **exchange rate** is also an important variable in determining the demand for money specifically in open economies. The exchange rate is taken as the Official exchange rate (LCU per US$, period average). The sign of the exchange rate coefficient is ambiguous with studies such as Narayan et al (2009) on South Asian countries finding a positive relationship between the exchange rate and money demand. It is positive if depreciation is seen as an increase in wealth by increasing the value of foreign assets leading to a rise in level of income (Nnyanzi, 2018).

(c) Interest rates is taken as Real interest rate (%) often used to capture the of opportunity cost of holding money. Normally it represents the nominal interest rate on time deposits kept in commercial banks. It reflects the degree of switching from the bonds, and other financial assets. According to the literature on money demand, this relationship is expected to be negative.

3.6.3 Gross Domestic Product (GDP)

Gross domestic product is the measure of all final goods and services produced within country's borders within a year in monetary values. GDP has been used as a proxy for the level of income. An increase in level of income leads to an increase in demand for money. The expected sign is positive.

3.6.4 Financial Innovation (Fv)

The selected proxies of financial innovation have portrayed a rising trend over the past 20 years. Data presentation on some key proxies of financial innovation has been gathered from leading commercial banks in Namibia, as alluded to earlier that rising trend can be seen for the past 20 years. Combined data indicate that there has been a stable growth in the number of ATMs used, Merchants, Point of Sale devices in use and electronic card use; this data point to the receptiveness of financial innovation in the Namibian economy as a means and innovative way of doing business.

3.6.5 Error Term (ε_t)

Andren (2008) postulated that an error term means that the model is not completely exact thus the error term will capture the divergence of this research's model from the real world. The error term will be critical in capturing variances in financial innovation and velocity of money not explained by the selected proxies included in the model.

3.7 Estimation Technique - Auto-Regressive Distributed lag error correction model (ARDL-ECM) co-integration technique

The Auto-Regressive Distributed lag (ARDL) co-integration technique is preferred. ARDL has an advantage over the other estimate for long run relationship between the underlying variables in small sample size (Pesaran et al.; 2001). A Unit root test will be done to avoid running a spurious regression. Followed by the optimal lags' criterion; lastly, the cointegration diagnostic test will be run in this study. It will then expand on the stated diagnostic tests and post estimation tests required by the study.

Firstly modelling the ARDL with appropriate lags corrects for serial correlation problems found in macroeconomic variables. Long run and short run dynamics (in terms of error correction model) simultaneously can be estimated, in the context of ARDL modelling (Narayan, 2004). The model provides unbiased estimation as it integrates the long run and short run dynamics. Using the ARDL approach of Pesaran and Shin (2000b), this study estimates the ARDL version of equation (6), which is specified as follows. To efficiently establish the impact of financial innovation on the velocity of money demand in Namibia, Equation 6 is transformed into the ARDL model as indicated in Equation 7;

$$\Delta LnVm_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1k} \Delta LnVm_{t-k} + \sum_{i=1}^{n} \alpha_{2k} \Delta LnGDP_{t-k} + \sum_{i=1}^{n} \alpha_{3k} \Delta OC_{t-k} +$$

$$\sum_{i=1}^{n} \alpha_{4k} \Delta LnFV_{t-k} + \beta_1 LnVm_{t-1} + \beta_2 LnGDP_{t-1} + \beta_3 OC_{t-1} + \beta_4 LnFV_{t-1} + \varepsilon t \quad \ldots\ldots (7)$$

Where Δ is the first difference operator, $\alpha 0$ is the constant term, the parameters $\alpha 1k$, $\alpha 2k$, $\alpha 3k$, and $\alpha 4k$, are the short-run coefficients while: $\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, represent the long-run coefficients. εt Is the error term, $t - 1$ is the lagged period for variables and indicate the lag order of the equation. The lags of the ARDL model are estimated using Akaike Information Criterion AIC to the four variables.

Consequently, ARDL co-integration technique is preferable when dealing with variables that are integrated of a different order, I(0), I(1) or a combination of them both and, robust when there is a single long run relationship between the underlying variables in a small sample size. The major advantage of this approach lies in its identification of the co-integrating vectors where there are multiple co-integrating vectors. The Error Correction Model (ECM) can be derived from the ARDL model through a simple linear transformation, which integrates short run adjustments with long run equilibrium without losing long run information. The associated ECM model takes a sufficient number of lags to capture the data generating process in general to specific modelling frameworks (Pesaran, Smith, & Shin; 2001). Following Hendry (1995), equation (7) is re-parameterized as an ECM to yield:

$$\Delta LnVm_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1k}\,\Delta LnVm_{t-k} + \sum_{i=1}^{n} \alpha_{2k}\,\Delta LnGDP_{t-k} + \sum_{i=1}^{n} \alpha_{3k}\,\Delta OC_{t-k} + \sum_{i=1}^{n} \alpha_{4k}\,\Delta LnFV_{t-k} + \lambda ECT_{t-1} + \varepsilon t_t \quad \ldots (8)$$

The coefficient of the error correction term is indicated by λ which represent the speed of adjustment to equilibrium. The larger the coefficient of the error term the more the speed adjustment of the model from the short run to the long run equilibrium. The error correction term, $ECTt-1$ coefficient is expected to be negative and significant to explain the speed adjustment to equilibrium.

3.7.1 Stationarity Test

The study conducts the unit root test to establish the time series characteristics of the data.

The test provide justification of the ARDL bound test approach as co-integration approach. A stationarity test is done to test for the presence of a unit root in time series data so as to avoid spurious regressions. Spurious regressions arise in time series regressions where one often obtains a very high R^2 (in excess of 0.9) even though there is no meaningful relationship (Gujarati, 2004). The presence of a unit root was checked using the Augmented Dickey-Fuller (ADF). The Augmented Dickey-Fuller (ADF) test is considered superior because of its popularity and wide application. The ADF test adjusts the Dickey-Fuller (DF) test to take care of possible autocorrelation in the error terms by adding the lagged difference term of the dependent variable. The Durbin Watson (DW) statistic was also used to affirm the stationarity of the variables. The R^2 was compared to individual DW statistics, the decision rule is that DW statistic value should be greater than R^2 to render our model acceptable for policy analysis. It is also important to note that the ARDL test can be used regardless of the presence of I(1) and I(0) variables. The ADF test decision criteria follow the following hypothesis as stated below.

Hypothesis; H_0: There is no unit root, and H_1: There is a unit root.

Decision rule: Reject the null hypothesis if the P-values are less than 0.05. Rejecting the null hypothesis means the variable is non-stationary.

3.7.2 Co-integration Test

This is a test done to test the presence of a long run relationship between the dependent variable and the independent variables. Co-integration is a test to determine a long-run relationship between variables. A co-integration test can be considered a pre-test to avoid spurious regression situations (Granger, 1969). The test is carried out using the ARDL bounds test. The ARDL bounds test approach has definite econometric advantages in relation to other co-integration tests such as Engle and Granger (1987), Johansen (1988), Johansen and Juselius (1990). The ARDL bounds test approach is used to test the level of relationship between variables. Testing for co-integration is highly crucial as it gives a degree of certainty to the relationships between variables. The order of integration is not very important in the ARDL bounds test approach unless the data is I(2) since the critical lower bound and upper bounds values for I(2) variables are not defined. This being said, the ARDL bounds test follows the hypothesis as shown below.

Hypothesis

H_0: There is no co-integration

H_1: There is co-integration

Decision rule: Reject the null hypothesis if the F-statistic is greater than the upper bound and the lower bound values.

3.7.3 Optimal Lags Selection

Optimal lag selection is a very crucial stage, and this ensures that we get the optimal estimates under the ARDL bounds test is obtained since the technique is sensitive to the lags employed during the estimation of the model. The Akaike Information Criterion (AIC) proposed by Greene (1993) was used on the choice of the lag length. The method allows each variable to enter the equation with different lags. The optimal lag criteria are very important as it gives us the lags that obtain the best results in the ARDL bounds test approach.

3.7.4 Multi-collinearity test

Multi-collinearity test is used to test if there is a serious correlation among the independent variables. If the independent variables are seriously correlated, then multi-collinearity is a problem. This study uses the pairwise correlation matrix approach to check for multi-collinearity. When using the pairwise correlation matrix, the absolute correlation coefficient between two exogenous variables should not exceed absolute 0.8, otherwise, multi-collinearity would be a serious problem (Gujarati, 2004). It is also important to note that a significant amount of correlation among variables was expected since the model is dealing with non-stationary series. However, according to Paul (2012), ARDL is a robust and dynamic method designed for that purpose and can therefore manage those cases successfully; in an ARDL, the lags are supposed to control for serial correlation and endogeneity.

3.7.5 Reset Test

A post estimation known as Regression Specification-Error Test was conducted. The main reason was to determine if the model contained any unnecessary extra variables, also to determine if the model was missing some or one other important variable and the third reason was to determine if there was any functional form misspecification, meaning a type of regression that was used to determine whether we could explain the relationship between the selected variables could be explained. The probability of the F-test is used to test for the validity of the whole model, which is compared to the 5% level of significance. R-squared is used to test the goodness of fit of the model and should be at least 50% for time series data (Gujarati & Porter, 2009).

3.7.6 Model Validity Tests

A model is deemed valid for interpretation of estimated results if it passes validity tests such as the F-test, positively related to R-squared. The probability of the F-test is used to test for the validity of the whole model, which is compared to the 5% level of significance. R-squared is used to test the goodness of fit of the model and should be at least 50% for time series data (Gujarati & Porter, 2009).

3.7.7 Heteroscedasticity Test

Heteroscedasticity occurs when the error term variance fluctuates across all the observations (Gujarati & Porter, 2009). They further emphasized that if we persist in using the usual testing procedures despite heteroscedasticity, the conclusions drawn, or inferences made may be misleading. The study utilized the Bruesch Pagan Godfrey Test and the hypothesis below was tested:

H_0: There is the absence of heteroscedasticity

H_1: There is the presence of heteroscedasticity

At 5% level of significance, the null hypothesis is not rejected if the probability value of the Bruesch-Pagan Godfrey test is greater than 0.05.

3.7.8 Autocorrelation Test

Gujarati (2004) clarifies autocorrelation as the correlation between members of a series of observations ordered in time. The presence of autocorrelation violates the mean-variance property, and this consequently limits the precision of the results. In this study, the Bruesch-Godfrey Serial Correlation LM test for serial correlation was employed to test for the presence of autocorrelation. The hypothesis below was tested.

Null hypothesis: There is no serial correlation.

Alternative Hypothesis: There is serial correlation.

The chi2 will be used as the decision rule, if it is less than 0.05 or 5%, the null hypothesis can be rejected. In other words, there is a serial correlation between the residuals in the model. Therefore, correct for the violation of the assumption of no serial correlation.

3.8 Data Types and Sources

The study used annual time-series data from the year 2000 to 2020 to sufficiently cover the period that has experienced the rise in financial innovation in Namibia. In addition, the study used economic and financial data obtained from the IMF, World Bank, Namibia Statistics Agency (NSA) and Bank of Namibia (BON). This data was selected because of its relative accessibility on the internet. However, the data being annual time series also faced difficulties in various data smoothing processes, which may influence the model's estimation capability.

3.9 Statistical and Econometric Software

The study employs STATA for data analysis and regression model estimation. The software is easy to use due to its command promptness, and the STATA software package have a strong ability to handle time series analysis.

3.10 Summary

The researcher has outlined and specified the model adapted for this study in this chapter. Sources and characteristics of data were highlighted, and the estimation methods were discussed as well. The model variables were justified giving the basis on the build-up to the presentation of findings and interpretations. The chapter further highlighted and briefly discussed the diagnostic tests to be applied. In the next chapter, an analysis and interpretation of the results will be presented.

CHAPTER 4

4. PRESENTATION AND INTERPRETATION OF RESULTS

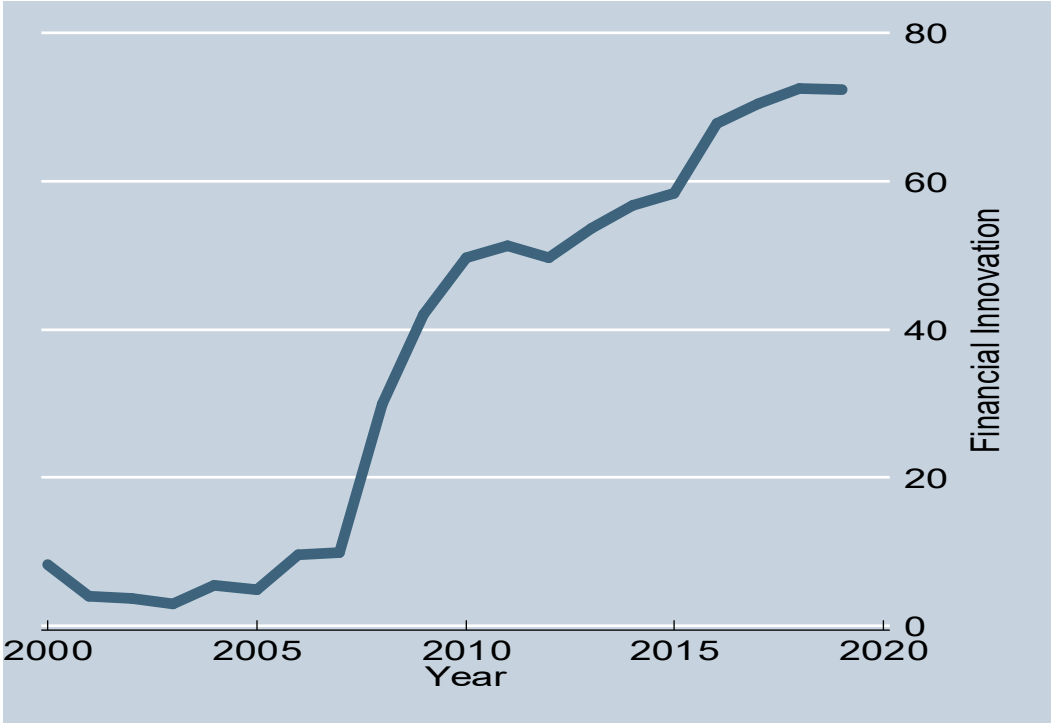
4.1 Introduction

4.2 This chapter presents the regression results of the specified model and proceeds to present the results of the diagnostics tests run pre and post estimation. This chapter focuses on the estimation of the model in order to determine the coefficients, the significance and reliability of the factors determining the relationship between financial innovations and velocity of money as well as GDP and the opportunity cost to hold money (2000-2020). The chapter presents summary statistics, results of relevant tests undertaken in the study and final regression and interpretation of results.

4.3 Graphical Analysis of the two main Variables (financial innovation and velocity of money)

The trend of the explanatory variables selected for this study, namely financial innovation, which is a sum of the Number of ATMs, Number of Merchants, Number of Electronic cards and Number of Point-of-Sale devices from the year 2000 to 2020, is presented in Figure 5, to follow.

Figure 5: Trend for Financial Innovations in Namibia (2000-2020)

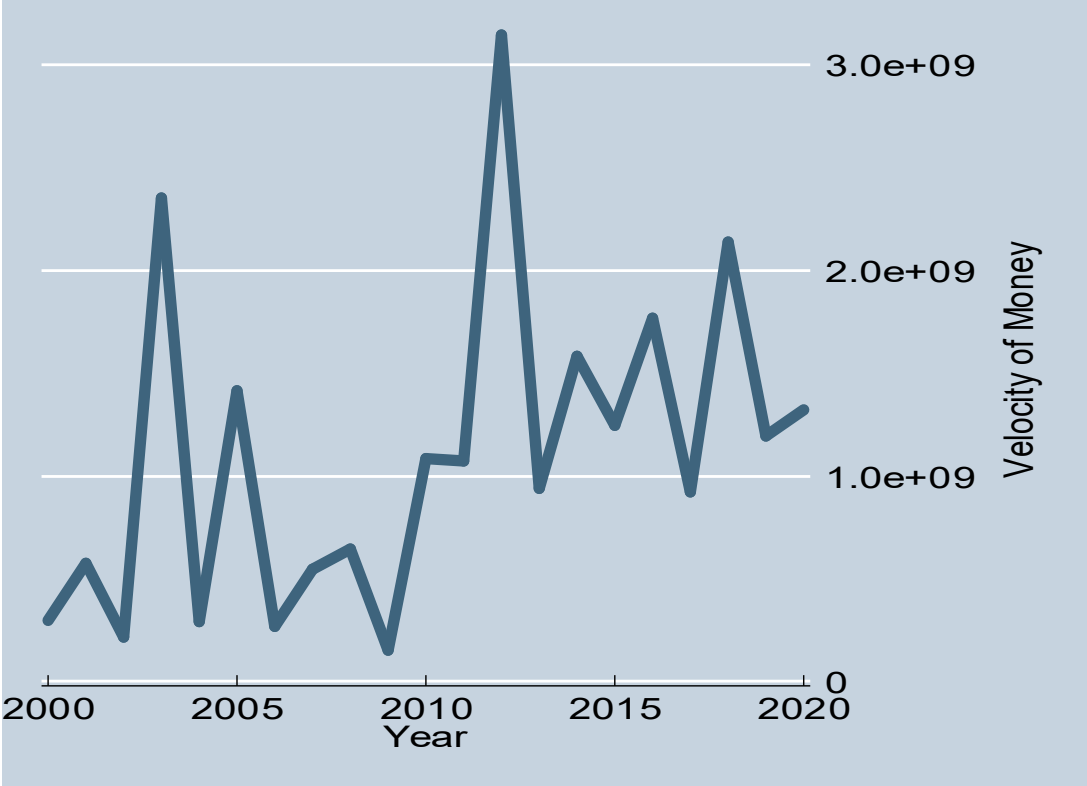


Source: Author`s Compilation

Figure 5 shows the variable fv in the converted form, in Logarithms (lg) form. This was done to equate the data to the same level and help with providing elasticity on the data set. More so, presenting the data in Logs was done to reduce the possibility of multi-collinearity. On Figure 5 indicates that the country`s financial innovation in the banking sector has been on a sharp rise since 2007, only slowing down but still rising recently. The graph also suggests that the variable in our data set is not stationary; hence, the need to proceed and carry out a Unit Root test to check for the stationarity since regressing non-stationary series may result in spurious results.

Figure 6 below also indicates the trend for velocity of money for the period 2000-2020; it is important to note that this graph is the after compilations to determine the true value of velocity of money. That is Velocity of money was calculated by dividing the money supply (m1 & m2) by the economy's Gross Domestic Product (GDP).

Figure 6: Trend for Velocity of Money in Namibia (2000-2020).



Source: Author`s Compilation

4.4 Unit Root Test Results/Stationarity Tests

Unit root tests using Augmented Dickey-Fuller test were undertaken to avoid working with non-stationary data, which yields spurious results. If the variables in the regression model are not stationary, then the standard assumptions for asymptotic analysis would not be valid. Table 1 presents the results of the unit root test.

Table 1: Unit Root Test – Data in Levels

Variable	ADF Probability	Order of Integration	Decision on H0	Remarks
LogVm	0.4325	I (0)	Do not Reject	Non-Stationary
LogGDP	0.0616*	I (0)	Reject	Stationary
OC	0.0136**	I (0)	Reject	Stationary
LogFv	0.6697	I (0)	Do not Reject	Non-Stationary

Source: Author`s Compilation, See Appendix D for actual STATA output

- **Denotes statistical significance at 10%, **significant at 5% and ***means significant at 1% and at all levels.*

Table 1 presents the results of ADF unit root tests; two variables, GDP (LogGDP) is stationary and integrated of order zero, and Opportunity Cost of Holding Money (OC) is also stationery and integrated of order zero. While the financial innovation (Fv) variable and Velocity of Money (Vm) are non-stationary. Stationary variables indicate that their magnitudes are not affected by time. The study applied the differencing approach to non-stationary variables, generating new variables and applying the ADF unit root tests. GDP will also be differenced since it was not level at the preferred 5% statistical significance range. Results are presented in table 2, below.

3.11 Table 2: Unit Root Test – First Difference

Variable	ADF Probability	Order of Integration	Decision on H0	Remarks

DlogVm	0.0005***	I (1)	Reject	Stationary
DlogGDP	0.0129***	I (1)	Reject	Stationary
DlogFv	0.0004***	I (1)	Reject	Stationary

** denotes statistical significance at* 10%, ** at 5% and ***at the 1% level.*

Source: Author`s Compilation, See Appendix for full STATA results.

As indicated by table 2, the ADF unit root tests demonstrate that the variables have become stationary after being differenced once. The differenced variables are now incorporated in the regressions. The variables are integrated of order one, I(1), implying that they become stationary after the first difference.

It is also essential to note that this study went on to difference the data as can be observed as presented by table 2; this was done to solve the non-stationarity problem. However, differencing data makes us commit at least some observations each time the difference is taken. Hence there is a tendency of drifting away from reality; that is, being biased towards forecasting at the expense of policy analysis as a drawback for differencing the data. Some observations can be seen to have been omitted in the variables in the tests to follow.

4.5 Summary Statistics Results

Descriptive statistics for the variables included in the regression model are presented in the table below. The common statistics are mean, minimum, maximum, standard deviation, skewness, kurtosis and number of observations.

Table 3: Descriptive Statistics

Variable	Mean	Variance	Std. Dev.	Skewness	Kurtosis	N
d.logVm	0.747412	1.454749	1.20613	0.531755	2.321431	20
d.logGDP	0.501785	0.020451	0.1430068	0.7281215	2.893265	20
OC	27.49904	23.29315	4.826298	-0.0863716	1.833005	21
d.logFv	0.1092322	0.1346514	0.3669487	0.7464545	4.906694	20

Source: Author`s Compilation, See Appendix for actual STATA results

Table 3 indicates the common descriptive statistics. The standard deviation indicates variability of data, the Opportunity cost of holding money variable (OC) has the greatest variability as indicated by a standard deviation of 4.826298. Further, velocity of money (dlogVm) has the second highest variability as indicated by a standard deviation of 1.20613, and the variable with the smallest variability is the GDP (dlogGDP) with a standard deviation of 0.1430068. The mean of most the variables under study is very low except for one, the Opportunity Cost of Holding money (OC) variable, it has the highest mean recorded of 27.49904 and the lowest recorded was 0.1092322 for financial innovation (Fv). Examination of the symmetry indicates that none of the series are perfectly symmetric, the most symmetric being OC with skewness of -0.08. The number of observations for stationary variables average, is 20.25 STATA statistical software is mainly used because of its ability to handle this time series phenomenon (Baum, 2006).

4.6 Multi-Collinearity Test Results

The relationship between explanatory variables is of importance in regression analysis. Explanatory strongly related variables cannot be included in the same regression equation. Table 4 presents the correlation between explanatory variables.

Table 4: Correlation Matrix

(obs=20)	d.logVm	d.logGDP	OC	d.logFv
d.logVm	***1.0000***			
d.logGDP	*0.2517*	***1.0000***		
OC	*-0.0465*	*-0.4764*	***1.0000***	
dlogFv	*-0.4371*	*0.1364*	*-0.0946*	***1.0000***

Source: Author STATA Correlation Results, See Appendix for actual STATA output

Table 4 above indicates correlation between explanatory variables. Using the rule of thumb on multi-collinearity correlation coefficients should be in the range of -0.8 to 0.8 in all of the variables, H_0 can then be accepted, and it can be concluded that there is no severe multi-collinearity among all the variables (Cameron and Trivedi, 2005). The study has established no strong relationship between the various explanatory variables.

4.7 Manual Optimal Lag Length Selection

Table 5 presents the findings of the optimal lag criterion chosen.

Table 5: Optimal lag criterion selection using the Akaike information criterion (AIC.

Varsoc (Variable)	Akaike information criterion (AIC),	Selected Optimal Lag length
d.logVm	2.31303*	1
d.logGDP	-1.54709*	0
OC	5.79232*	3
d.log Fv	0.398975*	2

Source: Author`s Compilation, See Appendix for actual STATA results

The optimal lag criterion is confirmed (1 0 3 2) for the Akaike information criterion (AIC), which optimal lags to be employed. Having presented on the optimal lag criterion, the researcher proceeds to present the results from the ARDL bounds test approach.

4.8 Cointegration Test Results

Under the ARDL bounds test approach, the researcher used STATA 14.2 to test the long-run relationship. In the multivariate approach, the bounds test is accompanied by the Pesaran tables (Pesaran et al., 2001), which indicate the critical upper bound values and the critical lower bound values crucial in determining whether there is a long run relationship or not. Using the built-in engines in STATA, the researcher obtained the following co-integration results in Table 6.

Table 6: Summary Bounds Test Co-Integration Results

Test Statistic	**Value**	**K**
F-statistic	17.821	3
Critical Value Bounds		
Significance	**Lower bound**	**Upper Bound**
5%	3.23	4.35

The hypothesis used for this test are H_0: there is no levels relationship and H_1: there is a levels relationship**.** The decision rule will be to reject the null hypothesis if the F-statistic is greater than the upper bound and the lower bound values.

After estimating the ARDL model in long run form and performing the bounds test procedure, table 6 summarizes the results. For the Bounds test, concern was mostly placed on the 5% significance level thus the conclusions are based on the 5% significance level. K in the table represents the number of independent variables in the model (number repressors).

There are two ways of concluding co-integration. The first is by using PSS (2001) F-test and the second is the use of the t-test on the ecm (-1) term. The F-test suggested by PSS (2001) is affected by the number of the first differenced terms in the model's right-hand side (Rhs). Therefore, it is always advisable to reinforce your co-integration using the t-ratio (Arize; 2017). The Bounds test for this study indicates that F-statistic is higher than both the lower bound critical values and the upper bound critical values, implying that there is a need to proceed to run a long run ARDL error correction model. The results indicate that there are levels of relationship (co-integration), hence we reject H_0. The results are also supported by the t-test value, which is greater than the critical value for I(0) regressors, affirming co-integration. The logical step was to proceed with the ARDL long run error correction test (Pesaran, Shin & Smith; 2001).

4.9 Analysis of ARDL Test Regression Results and Discussion of Findings

Optimal lags were selected earlier were used to run the model. The model has an R-squared of 94.12%, which is greater than 50%; this indicates that the model is of good fit. This means that 94.12% of variations in the velocity of money are explained by combined variations in the selected independent variables, which is financial innovation, income proxied by gross domestic product and the opportunity cost of holding money. The adjusted R-squared has a value of 87.51%. This is a quality check for R-squared and confirms the reliability of R-squared. In addition, the results indicate that all the coefficients are simultaneously not equal to zero at 1% level of significance since the p-value of F-statistic is 0.0000. Table 7, presents results obtained from the ARDL long run estimations using the Akaike information criterion (AIC) selected lags.

Table 7: ARDL Long run Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.862513	0.2521833	7.39	0.000***
d.logGDP	0.8191624	0.980541	2.84	0.030*
OC	0.0162597	0.052873	0.31	0.56
d.logFv	-0.5945483	0.5591343	4.06	0.04**
R-squared = 0.9412		Adjusted R-squared = 0.8751		Prob(F-statistic) = 0.0000

** Denotes statistical significance at *10%, ** at 5% and ***at the 1% level.*

Source: Author`s Compilation from STATA Results. See Appendix for actual results.

Table 7 presents the estimates of log run coefficients obtained from the ARDL model. The results indicate that in the short run and in the long run velocity of money was explained by financial innovations, which was statistically significant.

The velocity of money is positively related to income (GDP) levels as observed by the positive coefficients and is statistically significant at 5% level as shown by the Probability of 0.03 in Table 7. This entails that an increase in velocity of money by a unit increases growth in Gross domestic product (GDP) by 0.8191624 units, as shown by the coefficient, this was the anticipated sign because an increase in level of income leads to an increase in demand for money and therefore velocity of money increases. Further, the second variable tested that it the opportunity cost of holding money, the results indicate that there was no significant relationship between this variable and velocity of money in Namibia for the period under review. The views were confirmed by the low t-statistic of 0.31 which is below 2 and by a probability way above the 5% accepted level

of significance. However since the opportunity cost of holding money is made up of inflation, exchange rate and interest rate the expected sign was a negative sign, but in this case was found to be statistically insignificant. Now, on our main exogenous variable under study the financial innovations, the long run results show that there is a negative impact, which is a growth in financial innovations by a unit a decreases velocity of money circulation by -0.5945483 units, as shown by the coefficient.

Table 8: ARDL-ECM Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.588847	2.634553	4.22	0.01***
Δd.logGDP	1.525701	1.759128	2.87	0.04*
ΔOC	0.0302839	0.971293	0.31	0.59
Δd.logFv	-1.107354	1.008953	4.10	0.03**
ECM (-1)	0.862513	0.2521833	7.39	0.00***
R-squared = 0.9412		Adjusted R-squared = 0.8751		Prob (F-statistic) = 0.0000

** Denotes statistical significance at *10%, ** at 5% and ***at the 1% level.*

Source: Author`s Compilation from STATA Results. See Appendix for actual results.

The model has an R-squared of 94.12%, which is greater than 50%; this indicates that the model is of good fit. This means that 94.12% of variations in the velocity of money are explained by combined variations in the selected independent variables, which is financial innovation, income proxied by gross domestic product and the opportunity cost of holding money. The adjusted R-squared has a value of 87.51%. This is a quality

check for R-squared and confirms the reliability of R-squared. In addition, the results indicate that all the coefficients are simultaneously not equal to zero at 1% level of significance since the p-value of F-statistic is 0.0000.

The velocity of money is positively related to income (GDP) levels as observed by the positive coefficients and is statistically significant at 5% level as shown by the Probability of 0.04 in Table 8. This entails that an increase in velocity of money by a unit increases growth in Gross domestic product (GDP) by 1.525701 units, as shown by the coefficient, this was the anticipated sign because an increase in level of income leads to an increase in demand for money and therefore velocity of money increases. Further, the second result indicate also that an increase in velocity of money has no relation to opportunity cost of holding money as shown by the statistically insignificancy above the accepted 5% range and a low t-statistic way below the accepted 2+. Now, on our main exogenous variable under study the financial innovations, the error correction long term results show that indeed financial innovations affect the velocity of money in Namibia at least for the period understudy. This is noted by the probability of 0.03 which is statistically significant at 5% and a t-statistic of 4.10, which is above the 2 and above accepted range. The ARDL-ECM long run results show that there is a negative impact, which is increase in financial innovations by a unit decreases velocity of money by -1.107354 units, as shown by the negative coefficient.

The error correction term ECT (-1) is negative and statistically significant at 1 percent for velocity of money. The size of the estimated coefficient for the error correction term ECT (-1) indicates that the short run adjustments offset about 86.2 percent of the disequilibrium in velocity of money. A long-run consideration of financial innovation

has a negative effect on the velocity of money. This correction speed of adjustment is not comparatively consistent with other findings in other countries namely Botswana Motsewakgosi (2017) with 53% and Kayongo, Mukisa and Okum (2020) with 33%.

This means that financial innovation plays an important role in reduction velocity of money both in the short run and in the long run, as revealed by the results. For this study, and the coefficient of financial innovation is found to be negatively related to the velocity of money and significant, inferring that financial innovation that happened from the year 2000 to 2020, mainly in the banking sector, caused a reduction in the velocity of money in the Namibian economy.

The results are in line with Dunne and Kasekende (2016) findings in the literature review, more so, these findings acknowledge or concur with Apere (2017), who concluded that growth in financial innovation has the potential to enhance efficiency in an economy but can pose instability in the demand for money. The findings concur with Tillers (2004), who postulated that the definition implied by the theory assumes that the velocity of money depends on the quantity of money in circulation and the nominal income of the economy. It further confirms 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 results indicate that it is important for the monetary authorities to consider both economic and financial development stages in forecasting velocity of money for designing effective monetary policy.

Historically, to achieve the ultimate goal of price stability, central banks required a stable money demand function or understanding of the causes of the instability, as was the case with regard to the European Central Bank conversed earlier. Most central banks now work with a framework to 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 than 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 how monetary policy is conducted due to the instability of the money demand.

The results suggest the need to prioritize the key management and regulation of the banking sector-driven financial innovations as they have a tendency to negatively affect velocity of money, thereby ultimately affecting the monetary policy tool used by the apex bank that is the Bank of Namibia. This also indicates that financial innovations have had more impact on the economy and the decreased role of money demand in the economy. Much of the empirical evidence on this subject implicitly appears to disagree with these findings Adegboye et al. (2010) observed whether the financial innovations that happened in Nigeria subsequently following the then Structural Adjustment Programme of 1986 had altered demand for money. The research findings revealed that one of the main targets of the SAP programme of financial sector liberalisation, which led to financial innovation, had no significant influence on the demand for money or velocity of money in Nigeria. Additionally, a study conducted by the National Bank of

Rwanda in 2016 concluded that financial innovation in that country did not play an important role in determining money demand in the long run but only in the short run had it affected money dynamics in the economy. This corresponds with the founding literature on the Keynesian argument that in any economy, the demand for money is for three reasons explicitly: Speculative, transitionary and precautionary. Hence, the findings confirm that the money demand motives that in turn affected velocity of circulation remain unchanged, enabling people to transact using the innovative banking products to deposit and withdraw their money from their modern devices easily. It is also important to note that this also lessens the transitionary expenses, time costs, as well as transport costs, normally suffered when visiting physical banking halls. Hence the conclusion is that people are not so much excited about holding cash balances.

4.10 Post Estimation Results

4.10.1 Post estimation, the RESET test for the ARDL model

A post estimation known as Regression Specification-Error Test was conducted. The main reason was to determine if the model contained any unnecessary extra variables, also to determine if the model was missing some or one other important variable and the third reason was to ascertain if there was any functional form misspecification, meaning a type of regression that we used to determine whether we could explain the relationship between the selected variables could be explained. Below are the results of the RESET test obtained from the estat ovtest in STATA. Table 9 below presents the RESET test:

Table 9: RESET Results

Estat ovtest

Ramsey RESET test	using powers of the fitted values of D.dlogVm
Ho: model	has no omitted variables
F (3, 5) = 0.455	
Prob > F = 0.7363	

Source: Author`s STATA results compilations. See Appendix for actual results

The output from the table above indicates again using a significance p-value of 0.05; the null hypothesis for the RESET test is that the estimated model is correctly specified as to functional form given the variables included in the regression. The p-value for this test was 0.74 way above the 0.05 cut off, implying the model passes the test. This does not mean that this is the best model, but the model selected for this study was adequate according to the RESET diagnostic.

4.10.2 Autocorrelation Test Results

The Bruesch Godfrey Serial Correlation LM Test was used to test the relationship between the disturbance terms. The results are presented in Table 10.

Table 10: Autocorrelation Test Results

Breusch-Godfrey LM test for autocorrelation			
lags(p)	chi2	Df	Prob > chi2
1	0.064	1	0.8001

See appendix for full results.

The table above indicates that chi2 is more than 0.05 or 5%, the null hypothesis cannot be rejected. In other words, there is no serial correlation between the residuals in the model.

4.10.3 Heteroscedasticity Test Results

The Breusch-Pagan / Cook-Weisberg test for heteroscedasticity was utilized to detect the presence of heteroscedasticity in the model, and the results are presented in Table 11.

Table 11: Breusch-Pagan Godfrey Test Results

chi2(1) = 2.41
Prob > chi2 = 0.1204

See appendix I for full results.

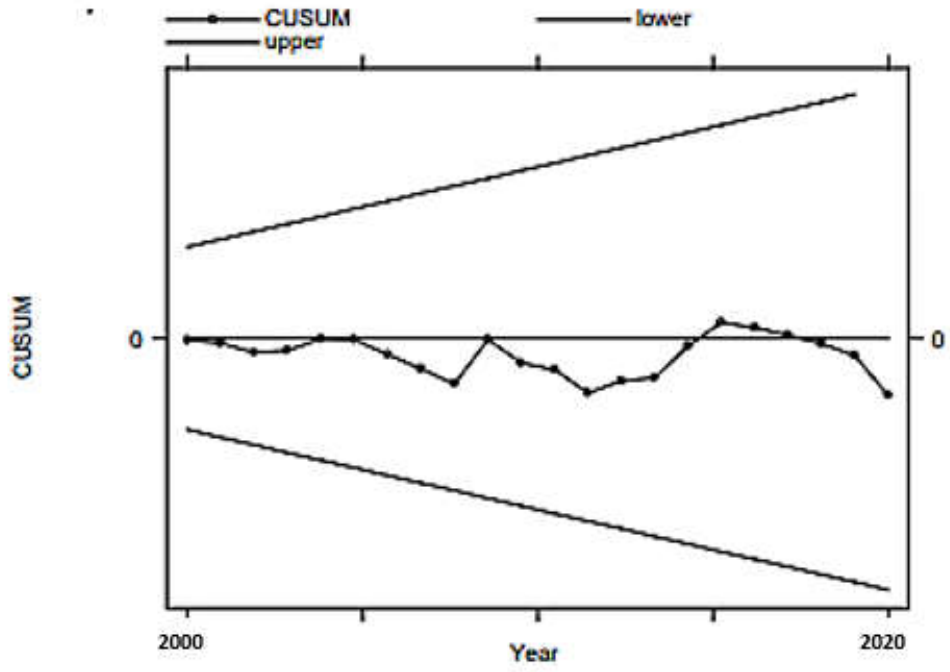
The Breusch-Pagan/Cook-Weisberg test concludes that if the probability value is greater than 0.05, there is no heteroscedasticity, and in this case, the probability value of the test is 0.1204, which is way greater than 0.05 at 5% level of significance. Therefore, there is no heteroscedasticity.

4.10.4 Model Stability Cusum6 Test

This study used the CUSUM test to test for the Model Stability as postulated by Brown, Durbin, and Evans, (1975). CUSUM test is founded on the cumulative sum of the recursive residuals. This option plots the cumulative sum together with the 5% critical

lines. Instability of the test can be noticed on the parameter if the cumulative sum goes outer the area between the two critical lines (Pooja, 2015), outside the 5% critical lines.

Figure 7: CUSUM6 plot



Source: Authors Compilation

For this research the CUSUM graph as shown in Figure 7, falls within the critical lines which is a proof that the model is stable and affirming the other post estimation test like the normality test and overally signifying stability of the tested model.

4.11 Summary

This chapter presented and discussed the study's empirical results. The ARDL results indicated that velocity of money was explained by the selected exogenous variables, specifically financial innovations, income and the opportunity cost of holding money for

both the short run and long run. The various test done to confirm this relationship, at least for this study. The next chapter provides policy recommendations and a conclusion based on these results.

CHAPTER 5

5. SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter contains a detailed conclusion to the study and provides some policy lessons drawn from the empirical results of the previous chapter. In addition, the chapter also provides possible areas for future research. It is important to also note that the analysis will concentrate on the two main variables (financial innovation and velocity of money) under study and silent on the other control variables, this was done to strictly bring out the results of the intended study without deviancies.

5.2 Summary of the Research Findings

The estimated model passed all the diagnostic tests. Hence, it can be concluded that the study produced parsimonious results. The selected explanatory variable financial innovation was statistically significant and exhibited their unexpected signs as earlier established in the literature.

In order to make a full summary of this study's findings, there is a need to recapitulate the objectives that founded this research, then decode each objective to the related findings to draw meaning and implication thereof. The primary research objective of this study was to: Assess the relationship between financial innovations and the velocity of money in Namibia. The secondary objectives derived from this primary objective are: To explore whether financial innovation explains the velocity of money in Namibia and to analyse whether there is a short run or long-run relationship between financial innovations and velocity of money.

The first objective of the study was fully achieved. The study found that there is a relationship and financial innovations explain the velocity of money in Namibia for the period chosen understudy from 2000 to 2020. Surely the Bank of Namibia and fiscal authorities can use this valuable information to govern monetary policy issues with respect to velocity of money and the regulation of the financial innovations, especially in the banking sector in Namibia. The actual results showed that an increase in financial innovations in the banking sector by a unit decreases velocity of money growth by -1.107354 units. This means that financial innovations play an important role in the demand for money role in the economy in the short run and in the long run. Hence, the relationship needs to be managed well as it has a bearing on monetary policy management; managing the velocity of money in the economy is a key monetary policy instrument, which can be used to contain inflation largely. The relationship between the variables (the negative relationship) and the margin of the effect is represented by the coefficients.

Moreover, the second objective is to analyse whether there is a short run or long run relationship between financial innovations and the velocity of money. The study established evidence of both the long run and short-run relationship between the variables. The Bounds test for this study indicated that F-statistic was higher than both the lower bound critical values and the upper bound critical values, which then led to the run long run ARDL error correction model being run. The results indicate the long run ARDL error correction model, which indicates that there is a levels relationship (co-integration). Hence, the results are also supported by the t- test value greater than the

critical value for I(0) regressors, affirming co-integration. The ARDL results indicate the existence of a negative relationship.

Much of the empirical evidence on this subject implicitly appears to disagree with these findings Adegboye et al. (2010) observed whether the financial innovations that happened in Nigeria subsequently following the then Structural Adjustment Programme of 1986 had altered demand for money. The research findings indicate that one of the main targets of the SAP programme of financial sector liberalisation, which led to financial innovation, had no significant influence on the demand for money or velocity of money in Nigeria. Additionally, the National Bank of Rwanda, in a study done in 2016, concluded that financial innovation in that country did not play an important role in determining money demand in the long run but only in the short run had it affected money dynamics in the economy. This corresponds with the founding literature on the Keynesian argument that in any economy, the demand for money is for three reasons explicitly: Speculative, transitionary and precautionary. Hence the findings confirm that the money demand motives that in turn affected velocity of circulation remain unchanged, just that people are not interested since they can transact using the innovative banking products to deposit and withdraw their money from their modern devices easily. It is also important to note that this also lessens the transitionary expenses, time costs, and transport costs normally incurred when visiting the physical banking halls. Hence, a take away is that people are not so much excited in holding cash balances.

This final chapter concludes the study by giving policy recommendations based on the research findings, summarising the whole study, examining the attainment of research goals, hypotheses, and research questions and pointed on suggested future research. The study established that financial innovations affected the velocity of money in the economy for both the short run and the long run; hence, policymakers need to break a balanced relationship between these two measures and make them work inclusively for the greater expansion of the Namibian economy.

5.3 Conclusion

The study attempted to empirically examine the relationship between financial innovation and the velocity of money in the Namibian economy. The study followed the selected variables from 2000 when there were developments in the financial sector in the country attained to 2020.

The study was motivated by the changes in financial innovations over the years; the Namibian financial sector experienced a lot of innovations intended on improving the proficiency with which banks and their clients transact. Many of the innovations were adopted by most banks over in the form of e-wallet services with Automated Teller Machines (ATMs) preferred to card-less cash withdrawals (Van Rooyen, 2018). The effects of the financial innovation in banking and financial markets on the velocity of circulation in Namibia has not been explored, given the lack of literature on the subject (Lando & Manuel, 2020). This study sought to empirically test the relationship between financial innovation and velocity of money from the year 2000 to 2020, which witnessed significant changes in the structure of the financial sector (institutions, instruments and markets) and resultant changes in money velocity in Namibia (Lando & Manuel, 2020).

Additionally, the study covers a stretched period ranging from 2000 - to 2020, covering 20 years during which there have been significant changes both in the financial innovations and velocity of money; the lengthy period under research is likely to give accurate results.

Using a time series, Auto Regressive Distributed Lag Error Correction (ARDL-EC) approach, the study established that both in the short run and long-run financial sector innovations is inseparably linked with the velocity of money. The results also established that an inverse relationship existed between the two variables, and the coefficients showed the margin of the relationship. Hence, cautionary advice would be extended to the policymakers to manage this dynamic better as it has a bearing on the monetary policy framework in the case of the velocity of money (money demand function) in an economy.

5.4 Recommendations

The study recommendations are mainly derived from study findings.

- ✓ Established from the findings gained from this study, it is evident that financial innovations have a considerable influence on the velocity of money in Namibia. This is ascribed to a huge number of people using modern banking platforms like ATM, an increase in the number of Merchants, Electronic cards, Number of Point of Sales devices, and affecting money circulation in the economy.
- ✓ The monetary authorities and fiscal authorities, for that reason, need to draft policies that intervene and can regulate/control the volume of transactions which can be traded on these platforms such as ATMs, number of merchants,

number of electric cards and number of point sales. This will safeguard the monetary policy instrument function of regulating money supply in the economy, and hence the money demand function can be maintained to an optimal level and hence will remain stable in the economy.

- ✓ The apex bank is also recommended to draft policies to control the accessibility of money credits via ATMs, number of merchants, number of electric cards and number of point sales. There ought to be an increased typical interest rate charged to banking clienteles borrowing loans/finances via these innovative banking platforms. A higher rate of interest would diminish the number of people borrowing credits/loans, thereby increasing the velocity of money thereby maintaining the control function of the central bank.
- ✓ Additionally, the intricacies brought by financial innovation with the introduction of these innovative novel banking products on the market, which is evidently changing the monetary aggregates, compel modifications of the broad monetary aggregates outside the M2 variable. Parenthetically, policy architects are required to sit and fittingly consider how these new explanations to monetary aggregates are affected by financial innovation how they relate to the monetary policy transmission framework; a possible notion this study put forward is the revision of the monetary policy tool to in calculating the financial innovation developments in the banking sector.

5.5 Future Research Areas

This study only determined the effect of financial innovation on the velocity of circulation in Namibia from the year 2000 to 2020. The study, however, was not able to integrate and incorporate other factors that affect the velocity of money in an economy like Exchange rate, Interest rate, Disposable income per capita, among other variables. The study also omitted other forms of financial innovations that have taken place in the country like the non-banking innovations, for example, stock market capitalization + domestic credit)/GDP, e-wallets and cellphone banking, among others. It is important to note that the initial model it included the variable of financial innovation to include the following ratios to represent financial innovations: total non-bank financial assets ratio (rna), time deposit-currency ratio (rtm), currency-money ratio (rcm) and the demand deposit-time deposit ratio (rdt) but gathering the data for those variables proved to be frugal as there was no publicly available data. Therefore, further research that includes these omitted variables need to be considered in future research on the subject matter. Future studies that could also target the growth and development of the broader financial sector ought to also encompass the diversification of financial instruments; it is probable that if different indicators/variables are considered, a resultant change in the outcome of the results is very much possible.

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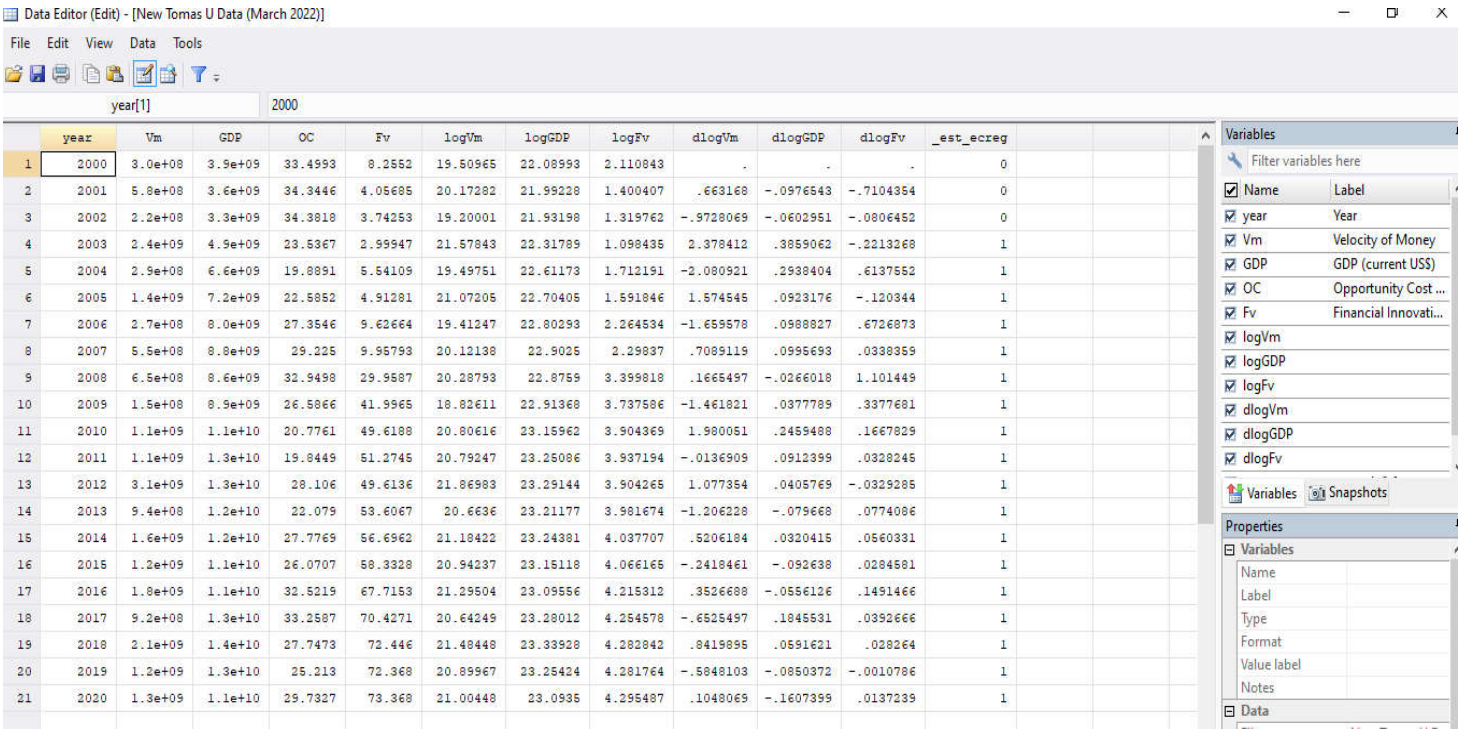
7 APPENDIXES

7.1APPENDIX A

DATA USED



	year	Vm	GDP	OC	Fv	logVm	logGDP	logFv	dlogVm	dlogGDP	dlogFv	_est_ecreg
1	2000	3.0e+08	3.9e+09	33.4993	8.2552	19.50965	22.08993	2.110843	.	.	.	0
2	2001	5.8e+08	3.6e+09	34.3446	4.05685	20.17282	21.99228	1.400407	.663168	-.0976543	-.7104354	0
3	2002	2.2e+08	3.3e+09	34.3818	3.74253	19.20001	21.93198	1.319762	-.9728069	-.0602951	-.0806452	0
4	2003	2.4e+09	4.9e+09	23.5367	2.99947	21.57843	22.31789	1.098435	2.378412	.3859062	-.2213268	1
5	2004	2.9e+08	6.6e+09	19.8891	5.54109	19.49751	22.61173	1.712191	-2.080921	.2938404	.6137552	1
6	2005	1.4e+09	7.2e+09	22.5852	4.91281	21.07205	22.70405	1.591846	1.574545	.0923176	-.120344	1
7	2006	2.7e+08	8.0e+09	27.3546	9.62664	19.41247	22.80293	2.264534	-1.659578	.0988827	.6726873	1
8	2007	5.5e+08	8.8e+09	29.225	9.95793	20.12138	22.9025	2.29837	.7089119	.0995693	.0338359	1
9	2008	6.5e+08	8.6e+09	32.9498	29.9587	20.28793	22.8759	3.399818	.1665497	-.0266018	1.101449	1
10	2009	1.5e+08	8.9e+09	26.5866	41.9965	18.82611	22.91368	3.737586	-1.461821	.0377789	.3377681	1
11	2010	1.1e+09	1.1e+10	20.7761	49.6188	20.80616	23.15962	3.904369	1.980051	.2459488	.1667829	1
12	2011	1.1e+09	1.3e+10	19.8449	51.2745	20.79247	23.25086	3.937194	-.0136909	.0912399	.0328245	1
13	2012	3.1e+09	1.3e+10	28.106	49.6136	21.86983	23.29144	3.904265	1.077354	.0405769	-.0329285	1
14	2013	9.4e+08	1.2e+10	22.079	53.6067	20.6636	23.21177	3.981674	-1.206228	-.079668	.0774086	1
15	2014	1.6e+09	1.2e+10	27.7769	56.6962	21.18422	23.24381	4.037707	.5206184	.0320415	.0560331	1
16	2015	1.2e+09	1.1e+10	26.0707	58.3328	20.94237	23.15118	4.066165	-.2418461	-.092638	.0284581	1
17	2016	1.8e+09	1.1e+10	32.5219	67.7153	21.29504	23.09556	4.215312	.3526688	-.0556126	.1491466	1
18	2017	9.2e+08	1.3e+10	33.2587	70.4271	20.64249	23.28012	4.254578	-.6525497	.1845531	.0392666	1
19	2018	2.1e+09	1.4e+10	27.7473	72.446	21.48448	23.33928	4.282842	.8419895	.0591621	.028264	1
20	2019	1.2e+09	1.3e+10	25.213	72.368	20.89967	23.25424	4.281764	-.5848103	-.0850372	-.0010786	1
21	2020	1.3e+09	1.1e+10	29.7327	73.368	21.00448	23.0935	4.295487	.1048069	-.1607399	.0137239	1

7.1 APPENDIX B

REGRESSION RESULTS

1. UNIT ROOT TEST

```
. dfuller logVm, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        19

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.697            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4325

. dfuller logGDP, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        19

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.778            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0616

. dfuller OC, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        19

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.330            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0136
```

```
. dfuller dlogVm, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        18

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -4.291            -3.750            -3.000           -2.630
——————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0005

. dfuller dlogGDP, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        18

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -3.346            -3.750            -3.000           -2.630
——————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0129
```

2. DESCRIPTIVE STATISTICS

```
. summarize dlogVm dlogGDP OC dlogFv
```

Variable	Obs	Mean	Std. Dev.	Min	Max
dlogVm	20	.0747412	1.20613	-2.080921	2.378412
dlogGDP	20	.0501785	.1430068	-.1607399	.3859062
OC	21	27.49904	4.826298	19.8449	34.38185
dlogFv	20	.1092322	.3669487	-.7104354	1.101449

```
. summarize dlogVm dlogGDP OC dlogFv, detail
```

dlogVm

Percentiles	Smallest		
1% -2.080921	-2.080921		
5% -1.87025	-1.659578		
10% -1.560699	-1.461821	Obs	20
25% -.8126783	-1.206228	Sum of Wgt.	20
50% .1356783		Mean	.0747412
	Largest	Std. Dev.	1.20613
75% .7754507	1.077354		
90% 1.777298	1.574545	Variance	1.454749
95% 2.179232	1.980051	Skewness	.0531755
99% 2.378412	2.378412	Kurtosis	2.321431

dlogGDP

Percentiles	Smallest		
1% -.1607399	-.1607399		
5% -.1291971	-.0976543		
10% -.0951462	-.092638	Obs	20
25% -.0699816	-.0850372	Sum of Wgt.	20
50% .0391779		Mean	.0501785
	Largest	Std. Dev.	.1430068
75% .099226	.1845531		
90% .2698946	.2459488	Variance	.020451
95% .3398733	.2938404	Skewness	.7281215
99% .3859062	.3859062	Kurtosis	2.893265

Opportunity Cost of holding money (OC)

Percentiles	Smallest		
1% 19.8449	19.8449		
5% 19.88911	19.88911		
10% 20.77615	20.77615	Obs	21
25% 23.53669	22.07903	Sum of Wgt.	21
50% 27.74731		Mean	27.49904
	Largest	Std. Dev.	4.826298
75% 32.52187	33.25869		
90% 33.49929	33.49929	Variance	23.29315
95% 34.34461	34.34461	Skewness	-.0863716
99% 34.38185	34.38185	Kurtosis	1.833005

dlogFv

Percentiles	Smallest		
1% -.7104354	-.7104354		
5% -.4658811	-.2213268		
10% -.1708354	-.120344	Obs	20
25% -.0170035	-.0806452	Sum of Wgt.	20
50% .0333302		Mean	.1092322
	Largest	Std. Dev.	.3669487
75% .1579647	.3377681		
90% .6432213	.6137552	Variance	.1346514
95% .8870679	.6726873	Skewness	.7464545
99% 1.101449	1.101449	Kurtosis	4.906694

3. MULTICOLINEARITY TEST

```
. correlate dlogVm dlogGDP OC dlogFv
(obs=20)
```

	dlogVm	dlogGDP	OC	dlogFv
dlogVm	1.0000			
dlogGDP	0.2517	1.0000		
OC	-0.0465	-0.4764	1.0000	
dlogFv	-0.4371	0.1364	-0.0946	1.0000

4. OPTIMAL LAG SELECTION

```
. varsoc dlogVm

   Selection-order criteria
   Sample:  2005 - 2020                        Number of obs      =        16
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-22.8206				1.15011	2.97757	2.98004	3.02586
1	-16.5043	12.633*	1	0.000	.592425*	2.31303*	2.31798*	2.40961*
2	-16.43	.14847	1	0.700	.667221	2.42875	2.43617	2.57361
3	-16.4189	.02223	1	0.881	.759809	2.55236	2.56225	2.74551
4	-15.2966	2.2446	1	0.134	.756408	2.53708	2.54944	2.77851

```
   Endogenous:  dlogVm
    Exogenous:  _cons

. varsoc dlogGDP

   Selection-order criteria
   Sample:  2005 - 2020                        Number of obs      =        16
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	13.3767				.012465*	-1.54709*	-1.54461*	-1.4988*
1	14.1208	1.4883	1	0.222	.012885	-1.5151	-1.51016	-1.41853
2	14.4066	.57145	1	0.450	.014133	-1.42582	-1.4184	-1.28096
3	14.6369	.46057	1	0.497	.01566	-1.32961	-1.31972	-1.13646
4	14.6395	.00521	1	0.942	.017932	-1.20493	-1.19257	-.963498

```
   Endogenous:  dlogGDP
    Exogenous:  _cons

. varsoc OC

   Selection-order criteria
   Sample:  2004 - 2020                        Number of obs      =        17
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-48.6707				20.2039	5.84361	5.84849	5.89263*
1	-47.2973	2.7468	1	0.097	19.354*	5.79968	5.80943*	5.89771
2	-46.3434	1.9078	1	0.167	19.5107	5.80511	5.81972	5.95214
3	-45.2347	2.2175	1	0.136	19.3642	5.79232*	5.8118	5.98837
4	-45.2301	.00907	1	0.924	21.9651	5.90943	5.93379	6.15449

```
   Endogenous:  OC
    Exogenous:  _cons

. varsoc dlogFv

   Selection-order criteria
   Sample:  2005 - 2020                        Number of obs      =        16
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-3.4562				.102214	.557025	.559498	.605312
1	-3.36556	.18128	1	0.670	.11465	.670695	.675641	.767269
2	-.191803	6.3475*	1	0.012	.087649*	.398975*	.406393*	.543836*
3	.313552	1.0107	1	0.315	.093832	.460806	.470697	.653953
4	.335968	.04483	1	0.832	.10718	.583004	.595367	.824438

5. ARDL BOUNDS TEST

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship F = 17.821
t = -7.386

Critical Values (0.1-0.01), **F-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_3	2.72	3.77	3.23	4.35	3.69	4.89	4.29	5.61

accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), **t-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_3	-2.57	-3.46	-2.86	-3.78	-3.13	-4.05	-3.43	-4.37

accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

6. POST ESTIMATION

```
. estat dwatson

Durbin-Watson d-statistic( 10,    18) =  1.925802

.
. estat archlm
LM test for autoregressive conditional heteroskedasticity (ARCH)
```

lags(*p*)	chi2	df	Prob > chi2
1	0.889	1	0.3457

H0: no ARCH effects *vs.* H1: ARCH(*p*) disturbance

```
.
. estat bgodfrey

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	0.064	1	0.8001

H0: no serial correlation

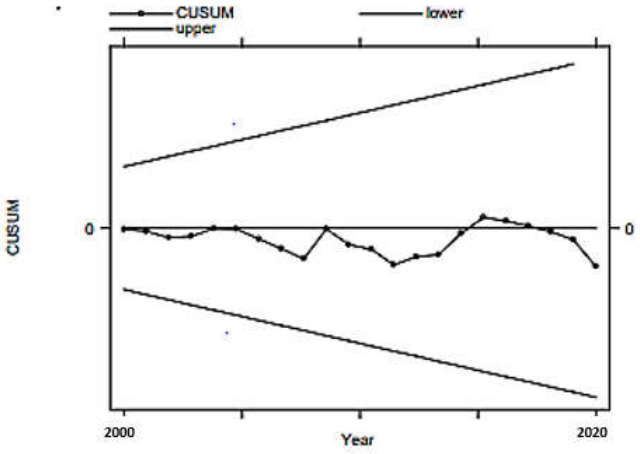
```
.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of D.dlogVm

         chi2(1)      =     2.41
         Prob > chi2  =   0.1204

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of D.dlogVm
       Ho:  model has no omitted variables
                   F(3, 5) =      0.44
                  Prob > F =      0.7363
```




```
. cusum _est_ecreg _est_ecreg, generate(cs)
```

Variable	Obs	Pr(1)	CusumL	zL	Pr>zL	CusumQ	zQ	Pr>zQ
_est_e~g	21	0.8571	2.57	2.482	0.007	2.14	1.967	0.025

7.2 APPENDIX C, SIMILARITY REPORT

Curiginal

Document Information

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W	URL: https://www.bnr.rw/fileadmin/user_upload/BNR_Economic_Review_9_220816_Print.pdf Fetched: 2021-11-05T13:16:41.4000000	14
W	URL: https://www.rbi.org.in/scripts/PublicationsView.aspx?id=13363 Fetched: 2021-11-05T23:55:29.1570000	1
SA	**final assignment Maria Cherednichenko.pdf** Document final assignment Maria Cherednichenko.pdf (D3134898)	7
SA	**EKHM12 Final Assignment Jacob Jorlén 820703.pdf** Document EKHM12 Final Assignment Jacob Jorlén 820703.pdf (D3134982)	1
SA	**christos_vassis_final_econ.pdf** Document christos_vassis_final_econ.pdf (D3135217)	2

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18 January 2021

To whom it may concern

LANGUAGE EDITING – TOMAS MEKONDJO UUGULU

This letter serves to confirm that a **MASTER OF BUSINESS ADMINISTRATION FINANCE (MBA-FINANCE) THESIS** entitled: THE NEXUS BETWEEN FINANCIAL INNOVATIONS AND VELOCITY OF MONEY: EVIDENCE FROM NAMIBIA was submitted to me for language editing.

The thesis was professionally edited and track changes and suggestions were made in the document. The research content or the author's intentions were not altered during the editing process and the author has the authority to accept or reject my suggestions.

Yours faithfully

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