THE IMPACT OF REAL EXCHANGE RATE DEVALUATION ON BILATERAL TRADE BALANCE: EVIDENCE FROM NAMIBIA AGAINST ITS MAJOR TRADING PARTNERS

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ABSTRACT

The main objective of the study was to investigate whether devaluation of real exchange rate has any impact on Namibia's bilateral trade balances against its main trading partners namely; Angola, Botswana, China, Spain, Germany, Italy, UK, USA, South Africa and Switzerland. The few studies that has focused on the relationship between real exchange rate and trade balance in the context of Namibia have employed aggregate trade data in the analysis. The use of aggregate trade data is known to have implications such as aggregation bias and spurious regression. In order to overcome these problems, the present study employed disaggregated trade data to investigate the impact of real exchange rate devaluation on Namibia's bilateral trade balance against its major trading partners. The study employed Autoregressive Distributive Lag Model (ARDL) and Error Correction Model (ECM) technique over quarterly data spanning from 1998:Q1 to 2018:Q4. Consequently, the study failed to find any evidence in support of the J-Curve effect (short run) and that the Marshall-Lerner condition does not hold for Namibia. These findings have implications that real exchange rate cannot be adopted as a policy to improve Namibia's bilateral trade balance against its main trading partners. Additionally, it was found that real domestic income and foreign incomes are significant in influencing Namibia's bilateral trade balances in some cases while insignificant in other cases. Hence, it is important for Namibia to embark on advanced production of import substitute goods in those cases were domestic and foreign incomes have an impact on trade balance in an effort to lower imports and encourage exports.

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List of Acronyms

ADF: Augmented Dicky Fuller

ARDL: Autoregressive Distributive Lag

BON: Bank of Namibia

CMA: Common Monetary Area

CPI: Consumer Price Index

ECM: Error Correction Model

EPZ: Export Processing Zone

GDP: Gross Domestic Product

HPP: Harambee Prosperity Plan

KPSS: Kwiatkowski, Phillips, Schmidt, Shin

NDP5: 5th National Development Plan

NSA: Namibia Statistics Agency

PP: Philip and Perron

UECM: Unrestricted Error Correction Model

UK: United Kingdom

USA: United States of America

VAR: Vector Auto Regression

VECM: Vector Error Correction Model

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Dedications

I dedicate this work to my beloved wife, Patience Saushini for her firm support and encouragement despite all odds and to our beloved daughter, Elidah Saushini who was born during this difficult time.

Declarations

I, Elijah Mweemba Saushini, 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. Furthermore, other author's work has been fully acknowledged and cited.

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Name of Student	**Signature**	**Date**

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Namibia is open to international trade just like most countries in the world. The essence of international trade to any country cannot be overemphasized despite its level of development. Zahonongo (2017), Yakubu and Akanegbu (2015), Nkasa (2015) and Thirwall (2000) as cited by Ahmad, Hayat and Lugman (2013) view international trade as an engine of economic growth and development following its vital role in improving living standards, providing employment opportunities and enabling consumers' access to a greater variety of goods and services. However, Matlasedi (2015) noted implications associated with international trade e.g. trade deficits, misalignment of exchange rates and disequilibrium in the balance of payments. These trade-related problems have affected many emerging economies including Namibia.

Nevertheless, it is not unusual for countries to experience trade imbalances, in particular trade deficit - a situation in which the value of exports does not match the value of imports in a given period. Trade deficit as described by Bahmani-Oskooee, Goswami and Talukdar (2008) is a major challenge but yet a common economic phenomenon for many economies, especially in Sub-Sahara Africa. Many countries including Namibia are constrained by persistent trade deficits. According to Mushendami, Manuel, Shifotoka and Nakusera (2017) a deficit is a great concern for Namibia given that one of the macroeconomic objectives of the country is to maintain a stable equilibrium in the balance of payment.

Most countries aspire to have a situation where the value of exports is matching the value of their imports, resulting in the difference between the two values to be zero (TB=0), although ideal, this situation is not possible in practice. Hence, the trade deficit is termed the most frequent occurring

problems faced by many countries as suggested by Oluyemi and Essi (2017), this forms the basis for the current study.

Namibia has found itself firmly in a grip of a trade deficit (goods and services) every year since its independence in 1990 except for the years 2005 and 2006. Moreover, merchandise trade balance has been negative every year since 1995 with the exception of the year 2006 (Sherbourne, 2017). In view of prolonged trade deficits, Namibia like many other countries that have experienced a similar phenomenon implemented various initiatives including export processing zone (EPZ) and various exporters' incentives. According to economic theory, these initiatives have the effect of fostering growth in the export sector which improves the value of exports, subsequently, improving the country's trade balance. Nonetheless, for Namibia the experience is rather different as Sherbourne (2017) claims that the results following these interventions, in particular the EPZ, have been way below expectations. In the same view, Gibbon, Jones and Thomsen (2008) confirm that since around 2000, the majority of World Bank supported EPZ have been unsuccessful.

More recent interventions such as: The Industrialization Policy, The Fifth National Development Plan (NDP5) and the famous Harambee Prosperity Plan have all suggested for the development of the manufacturing sector, in order to strengthen the country's export position, but these have not yet come to fruition.

As indicated by Bakhromov (2011), real exchange rate has been cited as one of the most important indicators that measures international competitiveness of a country and therefore has a strong influence on a country's development on foreign trade. Wang (2009) and Chiloane (2013) stated further that it measures the value of a country's goods against those of another country at a prevailing nominal exchange rate, hence it is widely used indicator whose control leads to a chain

reaction of effects on the economy. Subsequently, the exchange rate has become a common macroeconomic policy for improving the trade deficit in many countries.

The Namibian dollar has depreciated massively since 1990 (Mudenda & Sherbourne, 2001). Whereas in 1990 just over N$2.5 were needed to buy a single US dollar (US$), and by 2001 the rates has increased to over N$8.00 per US$. In 2014, depreciation of the Namibian dollar continued against major currencies such as the USD, Euro (EUR) and Great British Pound (GBP), trading with the US$ at N$10.81, the lowest since 2008. Furthermore, depreciation of the Namibian dollar hit a near seven-year low against the GBP, trading at N$17.70 (Matlasedi, 2015). Moreover, the Namibian dollar lost 9.5 percent of its value against major currencies between January 2013 and December 2014. According to Mittner (2014) as cited by Matlasedi (2015) in the next five years i.e. 2014 to 2018, the Namibia dollar may stay week against the world's major currencies. Recent figures provided by South African Reserve Bank (April, 2019), show that the exchange rate has declined even further, trading at N$14.15, N$15.01 and N$18.46 against the US$, EUR and GBP respectively. This confirms Mittner (2014) as cited by Matlasedi (2015) assertion of a much weaker currency in the period 2014 to 2018.

In light of the above, it is clear that in Namibia, the trade balance (deficit) and the exchange rate seem to be moving together. Hence, this study aims to investigate the impact of real exchange rate devaluation on Namibia's bilateral trade balance against its main trading partners, taking a different approach from Eita (2013) who estimated the Marshall Lerner Condition for Namibia using cointegrated VAR over aggregated data and found that the M-L Condition holds for Namibia. The current study employed disaggregated data at country level.

In order to provide more insight about the relevant importance of each partner, Table 1 provides the shares of Namibia's bilateral trade flow with its top ten trading partners. It can clearly be seen that Namibia depends on South Africa for about 44.7 percent of its import requirements while 5.7 percent of the country's imports needs were met by China. The remaining group of eight countries contributed less than 5 percent to Namibia's total imports. On the other hand, export composition took a different turn with China being the largest export market taking up 17.7 percent of total exports followed by South Africa at 16.1 percent. Coming in third and fourth places was Botswana and the UK absorbing 10 percent and 6.7 percent respectively. The remaining countries contributions ranged between 4.1 percent and 0.7 percent. The concentration of Namibia's trade to these few countries provides an opportunity for Namibia to diversify its export and import markets.

Table 1. Namibia's bilateral trade flow with its major trading partners for 2018

Trading partner	**Export value (N$ m)**	**Exports/total exports (%)**	**Import value (N$ m)**	**Imports/total imports (%)**
Angola	679	0.7	39	0.0
Botswana	9,245	10.0	4,515	4.1
Switzerland	889	1.0	325	0.3
China	16,410	17.7	6,352	5.7
Germany	779	0.8	1,062	1.0
Spain	3,857	4.2	1,397	1.3
UK	6,174	6.7	2,662	2.4
Italy	3,039	3.3	474	0.4
US	1,482	1.6	2,217	2.0

South Africa	14,910	16.1	49,349	44.7
Total	57,464	61.9	68,392	62.0

Source: Trade Statistics, Namibia Statistics Agency

This study is organized as follows. Chapter two contains a discussion of literature focusing on both theoretical and empirical literature. The analytical framework and methodology of the study is presented and discussed in Chapter three while Chapter four presents empirical results and their interpretation as well as how they compare to estimates in the literature. Finally, Chapter five presents the findings as well as policy implications stemming from the empirical results.

1.2 Statement of the Problem

Namibia depends on international trade without which it cannot thrive in terms of economic growth and development. This dependency is associated to the country's small economy coupled with a narrow manufacturing base as well as the structure of its economy as inherited at independence (Sherbourne, 2017). The past three decades have seen Namibia plagued with a persistent trade deficit; averaging to N$18.599 billion in the period 2009 to 2018 as reported in the NSA Annual Trade Statistics Bulletin of 2019. The trade balance for the year 2018 recorded a deficit of N$17.380 billion representing 9 percent of the country's GDP. According to Nkasa (2015) trade deficits have severe economic implications and the exchange rate, is the most important policy tool that is commonly used to improve the country's trade balance position.

Namibia joined the Common Monetary Area (CMA) after attaining its independence in 1990, thereafter, began to use a pegged exchange rate regime in 1992 (Alweendo, 1999). Under this regime, the Namibia dollar is pegged 1:1 with the South African rand, meaning that the rand's performance on international market determines the exchange rate for the Namibian dollar. This

arrangement has implications on possible policy options available for the Namibia government. Monetary policy i.e. expansionary/contractionary becomes ineffective as a policy option in a fixed exchange rate regime. Hence, any changes in money supply will have no effects on output or the exchange rate in a fixed peg system (Lungu & Sheefeni, 2014). As such, the trade balance, unemployment and interest rates all remain the same. Subsequently, with a pegged exchange rate Namibia cannot pursue domestic goals with its monetary policy due to lack of autonomy". According to Alweendo (1999) Namibia can hardly use exchange rates or interest rates to mitigate the impact of external shocks which are highly likely due to the country's degree of openness. Additionally, the CMA arrangement exert limits on fiscal policy for Namibia due to its inability to finance budget deficits by printing money (Tjirongo, 1998).

By devaluing its currency, a country makes its exports more competitive and imports more expensive which leads to an increase in exports and a decrease in imports, hence the country's trade balance recovers, subsequently improving economic welfare, (Oluyemi & Essi, 2017).

Whether devaluation of the real exchange rate has an impact on trade balance remains a pertinent question to be answered for the case of Namibia. Many studies that has been done on this subject are inconclusive due to mixed results. Tandon (2014) argues that there is equal evidence supporting the presence and or lack of this relationship. Studies focusing on the real exchange rate - trade balance relationship on Namibia are scarce; to the best knowledge of the author only two studies thus far have focused on Namibia. However, such studies employed aggregate trade data in the analysis, which may suffer from aggregation bias that can be present when aggregate data is used as pointed out by various authors such as Bahmani-Oskooee, Goswami and Talukdar (2005), Bahmani-Oskooee, Goswami and Talukdar (2008), Bahmani-Oskooee and Kovyryalova (2008).

Thus, the purpose of this study is to investigate the short run (J-Curve effect) impact of real exchange rate devaluation on Namibia's bilateral trade balance against its main trading partners.

1.3 Objectives of the Study

Objectives of the study

The main objective of the study was to investigate whether devaluation of real exchange rate has any impact on Namibia's bilateral trade balances against its main trading partners namely; Angola, Botswana, China, Spain, Germany, Italy, UK, USA, South Africa and Switzerland.

The specific objectives of the study are:

- To determine whether or not there is a long run relationship between real exchange rate and bilateral trade balance for the case of Namibia and its main trading partners;
- To evaluate if there is any evidence that the J-Curve effects in Namibia's bilateral trade with each of its main trading partners;
- To assess if the Marshall-Lerner condition holds true for Namibia.

1.4 Research Hypotheses

Subsequent to the objectives outlined above, the following hypotheses were tested.

- Hypothesis-1: $H_{0;}$ There is no long run relationship between real exchange rate and bilateral trade balance in the case of Namibia and its main trading partners;

  H_1: There is a long run relationship between real exchange rate and bilateral trade balance in the case of Namibia and its main trading partners.

- Hypothesis-2: $H_{0;}$ There is no evidence supporting the existence of the J-Curve effect in Namibia's bilateral trade;

  H_1: There is evidence the J-Curve effect in Namibia's bilateral trade.

- Hypothesis-3: $H_{0;}$ The Marshall-Lerner condition does not hold in the case of Namibia;
- H_1: The Marshall-Lerner condition holds in the case of Namibia.

1.5 Significance of the Study

The present study contributes to a body of already existing knowledge on the dynamics of bilateral trade balance by considering the case of Namibia with each of its main trading partners while its findings offers policy advice. Additionally, since Namibia is known for its persistent trade deficit, the study of the impact of devaluation in Namibia is vital as it will shed more light on the current trend of the trade balance and real exchange rate situation in the country. This is an interesting study for a country like Namibia considering that it is in a CMA arrangement in which the Namibian dollar is pegged to the South African rand which determines the former's exchange rate on the international market. Namibia's fixed exchange regime has been a bone of contention lately. Fixed but stable exchange rates are vital to national and global economic stability but for Namibia this has not been the case due to recent volatility of the rand to major currencies. Part of the economic crisis Namibia is currently facing, among many factors, is the pegging of the Namibian dollar to the South African rand which has performed poorly causing the Namibian dollar to follow suit. This has sparked a lot of debate from many economists whether Namibia must abandon the fixed peg for alternative systems such as the floating exchange rate system which could liberate Namibia to execute independent monetary policies that suits its domestic needs. Although some economists advocate for de-pegging, others are against de-pegging citing financial mayhem

irrespective of the size of the economy or whether it is an import or export based economy. Finally, the current study is significant in the sense that it differentiates between what is already known from established theoretical foundation and the real situation as supported by empirical literature.

1.6 Limitations of the Study

The study employed quarterly data covering the period from 1998:Q1 to 2018:Q4. The data was restricted from 1998 because of unavailability of disaggregated merchandize trade data before 1998 for Namibia. The study was also limited by lack of exchange rate data for Namibia as the Namibian dollar does not trade on the international market. Hence, the South African exchange rate was used as a proxy for the local currency's exchange rate, given that the Namibian dollar is pegged 1:1 to the South African rand. Additionally, the Consumer Price Index (CPI) data for Namibian during the period 1998 and 1999 was based on Windhoek only, this is because compilation of national CPI only started in 2000 onwards. Until 1998, the mark, French franc, lira and peseta were the respective currencies used by Germany, France, Italy and Spain. In 1999, these four countries adopted the Euro as the official legal tender; hence the exchange rate for these countries was calculated based on the Euro starting from 1999.

1.7 Delimitations of the Study

The study focused mainly on Namibia's trade balance, in particular merchandise trade balance, that is, Namibia's trade balance with its main trading partners in goods only. This is because net-export is the largest component of the balance of payments (BOP) current account. The study is applicable to the entire economy as national data was employed in the analysis.

1.8 Research Ethics

The study undertakes to ensure that all data sources and the work of other authors used in this study were properly acknowledged and the study reflects the original work of the author.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The focus of this Chapter is to discuss the theories that relates real exchange rate to the trade balance. Many authors have tried to explain this relationship which led to the discovery of various theories on this subject. In this study more attention is drawn to the following theories: standard theory of international trade, Keynesian approach, absorption approach and monetary approach. Additionally, this chapter also discusses a wide body of empirical literature on this topic. Empirical literature on this subject is vast and have been divided or grouped in different categories by different authors e.g. in this study empirical literature is divided in three groups (1) Empirical studies based on aggregate trade data, (2) Empirical studies based on disaggregated trade data at country level and (3) Empirical studies based on disaggregated data at commodity level.

2.2 Theoretical Literature

Discussions from previous sections revealed that domestic currency devaluation is an important policy tool that a country can adopt in a bid to reduce/eliminate perpetual trade deficits. Since the country's trade deficit is captured in the balance of payment (BOP) as asserted by Wang (2009), itis worth reviewing various theoretical views and approaches relevant to the BOP, emphasizing more on those theories that have attempted to explain the relationship between the country's exchange rate and its trade balance. Ali *et al* (2014) presents alternative theories that focus on the effects of exchange rate on a country's trade balance, namely: (a) the standard theory of international trade, (b) Keynesian approach (c) absorption approach and (d) monetary approach.

Although equally important, some theories such as the standard theory of international trade and the Keynesian theory have emerged as the most empirically tested theories.

A country's trade balance is summarized in what is known as the balance of payment (BOP), ideally, the balance of payment is supposed to be nil but it is not always the case in reality (Wang, 2009). Many countries face imbalances in their current account with a few cases recording a surplus while most find themselves in a deficit.

2.2.1 Defining the balance of payment

McConnell and Bruce (2005) term the balance of payment as a systematic summary of all the transactions that took place between the individuals, firms and government units of domestic resident and the rest of the world in a given period. Furthermore, the 5th edition of the IMF's Balance of Payments Manual (1993) defines the BOP as a "statistical statement that systematically summarizes, for a specific time period, the economic transactions of an economy with the rest of the world". Transactions, for the most part between residents and nonresidents, consist of those involving goods, services, and income; those involving financial claims on, and liabilities to the rest of the world and those (such as gifts) classified as transfers, which involve offsetting entries to balance. The balance of payments, also known as the balance of international payments, is often abbreviated as BOP.

In any given economy the BOP plays a vital role as it provides an account of financial transactions and status of a nation and its economy. Furthermore, it highlights the direction of economic growth or lack of it and forms the basis upon which many important policy decisions are made (McConnell & Bruce, 2005).

According to Wang (2009), transactions in the balance of payments are presented in the form of a double entry bookkeeping system in which every transaction is recorded as both a credit and a debt with equal values, but bearing opposite signs. Wang (2009) further contend that a debit entry shows a purchase of foreign goods, services, and assets, which results in a decline in liabilities to foreigners and has a negative sign on a balance of payments account. A credit entry shows a sale of domestic goods, services, and assets, which incurs an increase in liabilities to foreigners and has a positive sign on a balance of payments account.

Many authors have described the balance of payments to comprise of two main accounts, namely the current account and the capital and financial account (McConnell &Bruce, 2005; Wang, 2009; Mishkin, 2004 and Chiloane, 2013). A distinction between these accounts is drawn by Sherbourne (2017) and Wang (2009) who explained that the current account records the value of a country's imports and exports of goods and services, income and current transfers with the rest of the world. On the other hand, the capital and financial account covers capital transfers, and acquisition or disposal of non-produced, non-financial assets, and financial assets and liabilities.

The balances in goods and services is the most important and largest component of the current account for most economies including Namibia, so important that they are commonly referred to as the trade balance (Wang, 2009). This account is divided in two sub-sections; firstly the goods sub-section which covers transactions that usually involve changes of ownership between residents and non-residents. This account is the main focus of this study as it explores how it is impacted by currency movement and whether or not the devaluation of the domestic currency will improve the account. Secondly, the services sub-section which focus on traditional items, such as travel and transportation that were included in the earlier version of the BOP Manual and also items that have become increasingly important nowadays in international transactions such as communications

services, construction services, computer and information services, financial and insurance services, royalties and license fees, personal, cultural, and recreational services, and many other business services and government services (Mishkin, 2004).

2.2.2 Standard theory of international trade

During the sixteenth and seventeenth century, Mercantilism was the dominant economic system of most industrialized nations (Ali *et al*, 2014). The idea behind Mercantilism about international trade is that the government regulated the economy and trade in an effort to promote domestic industries through exports and discouraging imports by imposing tariffs. It implied that a nation's wealth or wellbeing depended on its stock of gold and silver; hence, according to this notion exports were good while imports were considered bad. Additionally, Mercantilism was also known as a zero-sum game as it believed in selfish trade i.e. one way transaction and ignored enhancing world, rather than a positive-sum game in which both parties benefit. However, Mercantilism became a subject of heavy criticism after a considerable period of instability and economic failures. Behind Mercantilism's condemnation was Adam Smith's Wealth of Nations (1776) and David Ricardo's theory of comparative advantage (1817). Through their respective work, these authors advocated for what became known as the standard theory of international trade.

The standard theory of international trade adopts a simple but common sense approach in linking merchandise trade to fluctuations in the exchange rate. According to this theory, keeping all variables fixed, variations in the exchange rate affects both the value and volume of trade. If exchange rate increases (depreciates) in the domestic country, imports becomes more expensive, subsequently, domestic demand for foreign goods/services declines as opposed to a rise in foreign demand for domestic goods/services (exports), eventually, the trade balance improves (Ali *et al*,

2014). Hence, the weaker the domestic currency against currencies of its trading partners, the more trade surplus the country will record against its respective trading partners.

However, according to Lerner, a rise in exports and a subsequent decline in imports following a weaker currency do not necessarily imply an improvement of the trade balance and that the trade balance is not concerned with the volume of physical goods but rather concerned with the actual values (Ali, *et al* 2014, Wang, 2009). As a result, Lerner extended the standard theory of international trade by explaining that price elasticities of imports and exports are key elements in measuring the effects of real exchange rate variations on trade balance.

2.2.3 Keynesian Approach

Many scholars have explored various approaches to address the imbalances that occur in the current account's balance of payments, one such approach is the Keynesian approach/theory. The Keynesian approach has two distinct approaches, firstly, the elasticity approach comprising of the Marshall-Lerner Condition and the J-Curve phenomenon. Secondly is the Keynesian absorption approach (Mushendami *et al*, 2017; Matlasedi, 2015; Ali *et al*, 2014 and; Chiloane, 2013), these approaches are discussed in this subsection.

2.2.3.1 Elasticity Approach

The valuation of goods at international level is different due to tariffs, freight charges, insurance and different incoterms (e.g. CF, CIF, FOB etc.) which can be described as a set of rules which defines the responsibilities of buyers and sellers for the delivery of goods under the sales contract. Therefore, firms are confronted with important decisions about whether they are willing to export their products abroad or not. The overall response of trade to such relative price shocks is called trade elasticity which, Celac and Mejstřík (2014) stressed was developed from parameters on the

supply side of the economy. The Elasticity Approach also commonly known as the Bickerdike-Robinson-Metzler Model (BRM) was originally developed by Bickerdike in the 1920swho laid the foundation by modeling the nominal import and export prices as a function of import and export quantities, assuming no cross-price effects (Ali *et al*, 2014; Celac and Mejstřík, 2014; Brooks, 1999). Further, the analysis in this model is based on the separation of the markets for imports and exports; besides accounting for incomes of both domestic and foreign economy (Ogutu, 2014). Afterwards, Bickerdike's original idea was further advanced together with Robinson in 1947 and Metzler in 1948.

The advanced idea implied that the change in the foreign currency value of the trade balance depends upon the import and export supply and demand elasticities and the initial volume of trade (Brooks, 1999). Therefore, Ali et al (2014) submits that a devaluation (depreciation) of a domestic currency increases foreign demand for domestic goods, but this depends on the foreign country's elasticity of demand and vice versa. In other words, the impact of deliberate currency devaluation on trade balance is dependent on both demand elasticity of imports and the supply elasticity of foreign goods. Hence, if the decline in the value of domestic imports is greater than the decline in the value of domestic exports, the trade balance will improve. According to Shao (2008) the BRM model relies on a two-country (domestic and foreign), two goods (exported and imported) model and presents a partial equilibrium approach of a perfect competition model. Nevertheless, this version of the model was criticized and considered not reliable by Alfred Marshall (Celac &Mejstřík, 2014), mostly due to the fact that it does not completely reflect the improvement in the trade balance following a currency devaluation and also that the approach ignores all other variables such as income (Fleermuys, 2005). This is because, as outlined by Celac and Mejstřík (2014) that many combinations of trade elasticities can lead to different effects.

2.2.3.2 Marshall Lerner Condition

The Marshall-Lerner Condition, subsequently termed "M-L Condition) is one of the most famous conditions focusing on the exchange rate trade balance relationship. Assuming that the stable exchange rate could be the one to improve the trade balance (Ogutu, 2014). This condition according to Shao (2008) is a special case advanced from the BRM condition/elasticity approach by Alfred Marshall in 1923 and Lerner P. Metzler in 1944. Further, the M-L condition is the most influential approach in determining trade elasticities using the balance of payments (Celac & Mejstřík, 2014). According to Ali *et al* (2014), the M-L-condition seeks to answer the following question: In what circumstances does a real devaluation of currency (fixed or floating exchange rates) improve the trade balance of a country? Moreover, authors like Ali *et al* (2014), Rockiki (2013) as cited by Celac and Mejstřík (2014) outlined the following basic assumptions necessary for the M-L conditions to be deemed reliable;

- Net capital flows is nil. Only two goods are traded and the balance of payments equals the trade balance;
- Income is constant. There is full employment but the influence of income on domestic and foreign goods is ignored, only price count;
- Price of domestic and foreign goods must be expressed in their domestic currency;
- Foreign supply of goods has infinite elasticity and therefore allows the output to be determined by demand.

The Marshall-Lerner condition can be expressed as an equation in the following manner:

$$\varepsilon_X + \varepsilon_M > 1$$

It specifies that if domestic and foreign supply elasticities are infinitely elastic, and if income remains constant, then a devaluation improves the trade balance when the absolute value of the sum of domestic and foreign demand elasticities for imports, exceeds unity, (Celac & Mejstřík, 2014; Shao, 2008; Brooks, 1999; Hernán, 1998). On the contrary, if the sum is less than unity, the trade balance worsens in the presence of devaluation (Ali et al, 2014). This represents an unstable equilibrium and as pointed by Ali *et al* (2014) an economic model with an unstable equilibrium can be inefficient for measuring the exchange rate trade balance relationship.

When the M-L condition is satisfied, spending on imports declines, export revenues as a result of depreciation and current account moves closer to equilibrium. Additionally, at the levels of existing gross domestic product, the deficit will eventually fall as well. Finally, Brooks (1999) distinguished two methods of testing the M-L condition. The first method referred to as the elasticity approach as discussed earlier and involves directly estimating the import and export price elasticities. According to Brooks (1999) the second method is known as the indirect method which entails estimating the dynamic reaction of the trade balance to real domestic currency devaluation. The body of literature that uses the indirect method to test for the M-L condition is generally referred to as the J-Curve effect. The J-Curve effect is discussed in the subsequent section.

2.2.3.3 The J-Curve effect

Nearly three decades after the generalization of the Marshall Lerner Condition, another relevant case concerning the exchange rate - trade balance relationship came into existence, “the J-Curve effect”. The J-Curve effect was advanced by Stephen Magee in 1973 when the USA trade balance deteriorated in 1972 despite devaluation of the USA dollar in 1971 (Bahmani-Oskooee & Kovyryalova, 2008).It is considered a dynamic view of the M-L condition or the elasticity

approach in general. This is because it reflects how devaluation of a country's exchange rate affects its trade balance over time (Ali *et al*, 2014).

Theoretically, it is believed that a weaker currency tend to boost exports and discourage imports, resulting in an improvement in the trade balance. The J-Curve theory states that the dynamics of trade balance following currency devaluation can be divided into three adjustment periods: the currency-contract period, the pass-through period and the quantity adjustment period. The current-contract (short-run) period is defined as brief period immediately following devaluation in which contracts negotiated before the change is executed. The pass-through (value-effect) period is the period after devaluation in which prices can change but quantities of exports and imports remains constant. Finally, the quantity-adjustment (price effect) period is defined as the period in which quantities start to adjust in response to changes in prices.

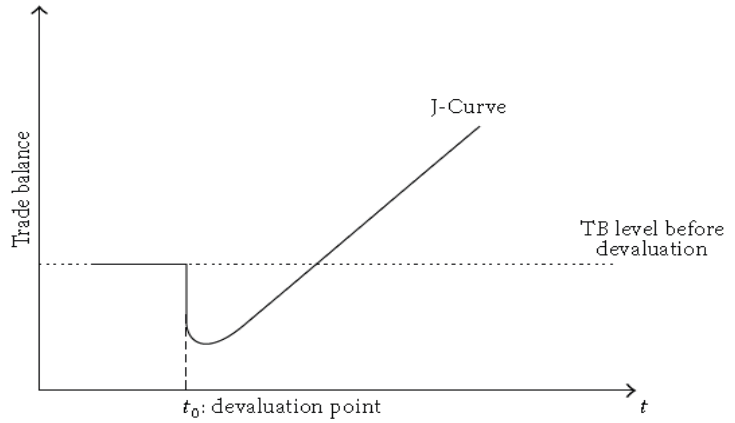
In the short-run, following currency devaluation, the price of imports rises and domestic importers find it more expensive to buy abroad with domestic currency; thus, the trade balance deficit improves. On the other hand, export prices declines and foreign buyers sourcing from the devaluating country find it less expensive to buy from the domestic country since the demand for exports and imports is fairly inelastic in the short-run (Ali *et al*, 2014). Chiloane (2013) cited delays in the change of consumer behavior and the lag of negotiating deals as the main causes of this demand inelasticity.

Put differently, in the short-run, when prices are relatively constant the balance of trade declines due to stickiness of prices and slowness to changes in demand. According to Ali *et al* (2014) price stickiness is when goods are still traded at the price level prior to devaluation. Moreover, Ali *et al* (2014) contend that the trade balance worsens by the value of total imports in foreign currency

multiplied by the magnitude of the rise in the price of foreign currency since contracts made before the depreciation force fixed prices and volume.

Afterwards, in the volume-adjustment period, as domestic residents respond to higher prices of imports, domestic demand begin to move from foreign goods to domestic production of substitute goods, subsequently improving the trade balance. Furthermore, the markets in the home country experience an increase in export volume due to the decrease in export prices following devaluation.

Figure 1: The J-Curve effect



Source: Ali et al (2014)

However, the J-Curve effect predicts the trade balance to improve in the long run to a higher level compared to its level before the depreciation. The dynamic reaction of trade balance as a short-run dip and long-run recovery takes the shape of the flattened letter "J" as can be seen in figure 1. The y-axis measures the trade balance while the time period is represented in the x-axis, when the J-Curve is above zero it shows trade surpluses and below zero reflects trade deficits. Figure 1 further assumes that depreciation occurs at t = 0, and that because people temporary still spend on imports as well as because exports do not sufficiently increase; the balance of trade worsens immediately after the depreciation. Only later, when import and export elasticities increase, does the trade balance turn around and eventually improve. The intuition behind the J-Curve effect is that devaluation of the exchange rate deteriorates the trade balance in the short run while improving it in the long run (Umoru & Oseme, 2013).It further implies that variations in the exchange rate have two effects on trade flows, namely: the Price effect and Volume effect. The price effect implies competitive

exports and more expensive imports. Since the volume of trade might not change drastically in the short run, the trade balance may initially deteriorate. Eventually the volume of trade changes in response to depreciation. In the long run, if the Marshall-Lerner (M-L) condition holds, the volume effect dominates and the trade balance improves. However, Chiloane (2013) argues that in case of a small country and a large country, both the M-L condition and the J-Curve does not differentiate the conditions under which the trade balance improves following currency devaluation.

2.2.3.4 Absorption approach

The absorption approach was developed and modeled in the 1950s by Harbeger, Meade and Alexander, and further elaborated by Johnson in 1972, combining both elasticities approach and Keynesian macroeconomics (Ali *et al*, 2014). Chiloane (2013:43) defines the absorption approach as "expenditure on goods and services". Moreover, this approach to the balance of payments assumes the variations in real income and real expenditure as pointed by Chiloane (2013) to be the main determinants of a country's trade balance and exchange rate. In this case, the trade balance is taken as the difference between aggregate domestic income and aggregate domestic expenditure rather than the difference between exports and imports (Ogutu, 2013). In other words, the trade balance is viewed as the difference between what is produced in an economy and what the economy consumes or absorb. The theory places more emphasis on how domestic spending on domestic goods changes relative to domestic output.

To identify the components of income and expenditure for any given economy, some authors for instance Chiloane (2013), Ali *et al* (2014) and Fleermuys (2005) adopted the famous Keynesian income model or the national income identity presented below:

$$Y = C + I + G + (X - M) \qquad 2.1$$

Where: Y= national income

C= final consumption expenditure by households

I= investment spending

G= final consumption expenditure by general government

X= expenditure on exports

M= expenditure on imports

Based on the above identity, the components C+I+G is aggregated into a single term, (A), which represents domestic absorption. Whereas (X-M) is also combined into a single term, (B), represents net-exports. Hence, equation 2.1 implies that total domestic output is given by the sum of domestic absorption and net-exports (Chiloane, 2013; Ali *et al*, 2014; Fleermuys, 2005). Moreover, it can be expressed as follows:

$$Y = A + B \qquad 2.2$$

Changing the subject of the formula, equation 2.2 becomes:

$$A = Y - B \; and \; B = Y - A \qquad 2.3$$

Equation 2.3 shows that the current account is determined by the difference between an economy's output and its absorption or expenditure. Given the above explanation and equation, Chiloane (2013) concludes as follows:

- If it is assumed that domestic production exceeds domestic spending, it means that exports are greater than imports. Implying that an economy is running a surplus current account; and

- If it is assumed that domestic production is lower than domestic spending, it means that exports are less than imports, hence showing a current account deficit.

Ali *et al* (2014) concludes that in the absorption approach, trade balance is expressed as a function of income and absorption expressed as $TB = f(Y, A)$. This implies that trade balance can improve if there is an increase in output (Y) or a decrease in domestic consumption (A) or both. Suppose domestic consumption is constant and the economy is not in full employment (mostly in developing countries); when currency devaluation occurs the ultimate effect is expected to be an increase in output, hence improving the trade balance.

2.2.4 Monetary Approach

The Monetary approach to the balance of payments (MABP) also known as the Monetary Approach (MA) was due to Robert Mundell and Harry Johnson, it became fully developed in the 1970s around the same time the J-Curve emerged (Eke, Eke and Obafemi, 2015; and Ali *et al*, 2014). Furthermore, Fleermuys (2005) explains the monetary approach as emanating from the David Hume price-specie-flow mechanism, which was launched as a criticism to the mercantilist belief that a country's wealth depended on its stock of gold and silver and that exports are good while imports are discouraged. Many authors, for instance Eke *et al* (2015), Ali *et al* (2014), Ogutu (2014), Chiloane (2013), Fleermuys (2005), agree that in the monetary approach the exchange rate-trade balance relations is purely monetary phenomenon caused by excess money supply. Mushendami *et al* (2017) explains that the monetary approach differs from the Keynesian approaches in that it takes into account both the current account and the capital account of the BOP

Ogutu (2014) argues that the monetary approach explains the trade balance by analyzing the demand and supply of money, given that money supply is controlled by the country's central bank.

According to Ali *et al* (2014) the trade balance is impacted by currency devaluation only through its effect on real money supply. Therefore, if there is excess domestic demand of money compared to the central bank's supply of money, the gap due to excess demand will have to be filled by foreign money, subsequently, the trade balance will improve. On the other hand, if there is excess money supply in the domestic economy than demanded, this may result to outflow of money from the domestic economy to foreign countries and hence, worsens the trade balance (Matlasedi et al, 2015; Ogutu, 2014). Subsequently, Ogutu (2014) contends that this approach assumes excess money demand and money supply have an effect on a country's trade balance. Nevertheless, currency devaluation may fail in the presence of subsequent increases in the nominal money supply that reestablish the original equilibrium. Hence, Ali *et al* (2014) concludes that the long-run effect on trade balance is not clear.

In the event of currency devaluation, Ali *et al* (2014) argue that the real value of money supply declines following an upsurge in the price of traded goods and services quoted in domestic prices, this can be mathematically presented as follows:

$$\frac{M^s}{P} = M^d(Y, E) \qquad 2.4$$

Where M^s is the nominal money supply, M^d is money demand, Y is income (output), and E is the nominal exchange rate. Equation 2.4 implies that devaluation of the exchange rate, E, increases the price of traded goods and services and hence, drops the value of real money balances which in turn reduces spending in order to balance the real value of its holding of money. Eventually, the decline in consumption leads to a subsequent reduction in absorption and trade balance improvement (Ali *et al*, 2014).

Chiloane (2013) shows that money supply and money demand channels of adjustments to the balance of payment equilibria depends heavily on the regime of exchange rate. The monetary approach under fixed exchange rate shows that a surplus in the balance of payments of a domestic economy emanates from excess demand for money which was satisfied by inflows of international reserves. On the contrary, a deficit in the balance of payments is due to excess money demand which was satisfied by an outflow of international reserves. Under the flexible exchange rate regime, if all other things are held constant, the excess supply of money tends to raise domestic prices which lead to depreciation. But for money demand and money supply to balance, Chiloane (2013) contends that domestic currency must depreciate in order to maintain equilibrium.

2.2.5 Overview of theoretical literature

Various theories exists that link real exchange rate to the country's trade balance. The review of this work commenced by looking at earlier development that saw the introduction of the standard theory of international trade. This theory states that variations in real exchange rate has a direct effect on the country's trade balance when all other factors are fixed. As simple as it sounds this is not applicable in real life, as most economies are open to trade which expose them to various external shocks that cannot be assumed not to exist, hence external shocks may distort the supposed relationship. Furthermore, this theory is based on assumptions that other factors are fixed, this assumption is not rational as there will always be other factors which may influence this relationship. Additionally, the theory is not specific in terms of the applicability of this relationship under different conditions i.e. whether a country is using a fixed or floating exchange rate regime.

The controversy around this theory lead to the development of the Keynesian theory which states that currency devaluation leads to the deterioration of a country's trade balance in the short run before improving it in the long run. This theory is among the most tested theories in economics literature but the empirical results on this theory have been mixed. The mixed results points at the fact the effects of exchange rate changes is not symmetric as assumed. Traders are market participants could have different expectations and different response to currency devaluations compared to appreciations. In this case, the trade balance could then respond in an asymmetric manner to variations in exchange rates. Hence, there is a need to turn to other views which could offer satisfactory results of the data. Finally, other related theories e.g. absorption approach and monetary approach have also been discussed.

2.3 Empirical Literature

According to economic theory, devaluation of the domestic currency worsens the trade balance in the short run before improving it in the long run, resulting in the so called J-Curve effect/phenomenon, (Bahmani-Oskooee, Goswami & Talukdar, 2008). It is called the J-Curve effect because the pattern of movement of the trade balance over time following devaluation resembles the tilted letter 'J' Brooks (1999).

After the advancement of the J-Curve effect in 1973 by Stephen Magee, testing of this phenomenon was only made possible in 1985 when Bahmani-Oskooee (1985) introduced for the first time a method that became famous in testing the J-Curve effect. Earlier studies following Magee (1973) used aggregate trade data (i.e., export and import data between one country and the rest of the world) to test the phenomenon. Such studies were outlined in the work of Yazici and Baba (2016),

for instance, the study by Junz and Rhomberg (1973), Miles (1979), Kruger (1983), Himarios (1985), Bahmani-Oskooee (1985), Brissimis and Leventankis (1989), Bahmani-Oskooee (1989). Moreover, Yazici and Baba (2016) stressed that the aforementioned studies played a pivotal role towards sharping the idea of the J-Curve phenomenon.

The second group of studies focused on trade between one country and each of its major trading partners, a disaggregation at bilateral level. This group of studies as William (2008) stressed, discovered more evidence in support of the J-Curve effect. Finally, a few studies in the last decade have disaggregated the trade data even further by focusing on the effect of real exchange rate on trade balance at sector or commodity level. Despite a large volume of empirical work on the effect of exchange rate of a country's trade balance that focused on both developing and developed countries, there is still no consensus on the results. The lack of consensus amongst this huge volume of work implies ambiguous results, leaving this subject highly debatable.

Based on the above, the study of the effect of exchange rate on the country's trade balance can be grouped in various ways e.g. studies that have focused on developed countries and developing countries (Stučka, 2004). This study categorized these studies in three groups, i.e., those that focused on aggregate trade data, those that disaggregated trade data between one country and each of its major trading partners and finally those studies that further disaggregated trade data to a sector or commodity level.

2.3.1 Aggregate Country Level

Among the studies that analyzed the long run and short run effect of real exchange rate on trade balance at aggregate level, Rehman and Afzal (2003) found mixed results upon testing the empirical validity of the J-Curve effect for Pakistan using autoregressive distributive lag model for a quarterly series between 1972:Q1 to 2002:Q4. The results showed evidence of the J-Curve effect while devaluation of the Pakistan rupee did not advance the trade balance in the long-run, implying no evidence in support of the M-L condition for Pakistan.

Yuel-Ling, Wai-Mun and Geoi-Mei (2008) found no evidence to support the existence of the J-Curve effect and the M-L condition for the economy of Malaysia. Yuel-Ling *et al* (2008) used annual data from 1955 to 2006 to examine the real exchange rate-trade balance relationship for Malaysia. By means of the unit root tests, cointegration, Engle-Granger test, and vector error correction model and impulse response analyses. The results showed no evidence of the existence of the J-Curve effect for Malaysia in that period. Further, it was found that depreciation of the domestic currency is not sufficient to improve the trade balance in the long run as purported by theory, therefore disapproving the M-L condition for Malaysia during the period of analysis.

Similar to Yuel-Ling (2008) finding on Malaysia, Tarasova (2009) employed various modelling techniques such as linear reparation analysis, simultaneous equation model and co-integration analysis to estimate the influence of exchange rate on the Ukrainian trade balance over a monthly sample period from 2002:1 to 2008:12. The author was unsuccessful in finding evidence supporting the existence of the J-Curve effect. Therefore, devaluation of the Ukrainian hryvnia has no effect on the trade balance in the short run and in the long run. These results are contrary to economic theory stressing that devaluation worsens the trade balance in the short run before improving it in the long run.

Tiwari and Shahbaz (2011) examines the preposition of the J-Curve effect and subsequently validated its existence in the case of India's trade with the USA after adopting ARDL, impulse response function and variance decomposing on an annual sample from 1965 to 2008. Further, Tiwari and Shahbaz found co-integrating relationship among the variables. Divergent from economic theory, a study by Ogundipe, Ojaenga and Ogundipe (2013) found no evidence in support of the J-Curve preposition for Nigeria. Using an annual data set from 1970 to 2010 and employing the Johansen-cointegration and variance decomposition analyses to investigate the impact of currency devaluation on Nigeria's trade balance. The results revealed that exchange rate induce an inelastic and significant relation on trade balance in the long run, furthermore, no short run causality was observed from exchange rate to trade balance. This study included money supply as an additional variable which was found to contribute more to variations in the trade balance than exchange rate. Implying that trade balance is impacted to a large extent by money supply and that devaluation worsens the trade balance in the long run.

Furthermore, in Namibia, Eita (2013) drew similar conclusions to Gebeyehu (2014), Igue and Ogunleye (2014) and Schalling and Kabundi (2014), after applying co-integration vector error correction modelling approach. Eita (2013) used annual data from 1991 to 2011 and found that real exchange rate has a significant impact on exports and imports and the sum of their elasticities was greater than 1 implying that the M-L condition holds in the case of Namibia. Gebeyehu (2014) carried out a study by employing co-integration approach, autoregressive distributive lag (ARDL) model; the Hendry's general to specific trade balance model which allows for a simultaneous short-run and long run analysis of the trade balance model, to estimate the J-Curve effect for Ethiopia over yearly data from 1974 to 2010. As expected from theory, Gebeyehu (2014) established strong evidence that devaluation of the domestic currency worsens the trade balance

in the short run before improving it in the long run. The author concludes that Ethiopian data for the sample period conform to the fulfillment of the J-Curve effect and that the Marshall-Lerner condition (M-L) holds for Ethiopia, hence, these results imply that exchange rate could be a useful policy tool for improving the trade balance in Ethiopia.

By means of ordinary least squares (OLS) and VECM modelling approaches, Igue and Ogunleye (2014) carried out a study to examine whether depreciation of the exchange rate would have a positive impact on Nigeria's trade balance in the long run based on the Marshall-Lerner condition. Using quarterly data from 1985:Q1 to 2010:Q4, the results suggest that depreciation of the exchange rate improves the trade balance in the long run, hence confirming the existence of the M-L condition in Nigeria. The results imply that exchange rate is a critical policy tool for narrowing the trade gap in Nigeria.

Further, Schalling and Kabundi (2014) carried out a study by using Vector Error Correction Modelling (VECM) approach to estimate South Africa's exchange rate-trade balance relationship both in the short run and long run (J-Curve effect and M-L condition). The authors employed quarterly data from 1994:Q1 to 2011:Q4 and found evidence in support of existing theory, implying that devaluation of the South African rand worsens the trade balance in the short run (J-Curve effect) before improving it in the long run (M-L). A different study done on the South Africa economy by Matlasedi, IIorah and Zhanje (2015) confirmed the results by Schalling and Kabundi (2014), that a depreciation of the South Africa rand improves the trade balance in the long run. Additionally, in the short run the depreciation of the rand leads to deterioration of the trade balance, thus approving the existence of the J-Curve effect for the South African economy.

Using a different approach, Eke *et al* (2015) applied Augmented Dickey Fuller test for unit root, Johansen test for co-integration among variables and error correction model (ECM) to investigate

the link between real exchange rate and trade balance in Nigeria. Using annual data from 1970 to 2012, it was found that co-integration test confirmed the long run relationship between trade balance, domestic income and world income. Furthermore, it was found that exchange rate has a significant negative impact on trade balance in Nigeria during the analyzing period. This implies that devaluation of the exchange rate worsens Nigeria's trade balance both in the short run and long run.

Similarly, Aliyu and Tijjani (2015) examined the long run pass through of the official exchange rate into trade balance in Nigeria from 1999 to 2012. By means of a threshold co-integration and asymmetric error correction modelling techniques, they established evidence of a slower transmission of exchange rate devaluation into the country's trade balance, which in turn appears to offer partial support for the Dutch disease hypothesis. The findings are not consistent with the J-Curve effect that expresses a negative relationship in the short run and a positive relationship in the long run between exchange rate and trade balance. Therefore, the authors established that currency devaluation is inappropriate as a policy tool that can be used to improve the trade balance in Nigeria. This also collaborates with findings by Hoang (2016) and Oluyemi and Essi (2017). Hoang (2016) carried out a study by applying a structural vector auto regression (SVAR) and VECM approach to analyze the short run and long run effects of foreign exchange rate on Vietnam's trade balance, using monthly data from 2004:1 to 2014:12. The results suggest that in the short run, variations in the exchange rate have very little impact on trade flows; while in the long run, it does not affect imports in either nominal or real terms but has strong effect on nominal exports. Oluyemi and Essi (2017) carried out a study by adopting the vector autoregression (VAR) approach, while utilizing a monthly data sample from1996:1 to 2015:12 to examining the effect of exchange rate on imports and exports in Nigeria.

Thom (2017) analyzed the movement of exchange rate and trade balance and investigated whether devaluation of the Vietnamese currency would improve the trade balance via the J-Curve effect from 2001:Q1 to 2015:Q4. The study employed a VAR approach, thereafter concluded that following currency devaluation the trade balance deteriorates in the first two quarters and starts to improve until the sixth quarter, afterwards, the trade balance declined followed by a series of unexpected upswing and downswing. Finally, the author established that instead of following a pattern of the J-Curve after devaluation, the trade balance follows a pattern of an S curve.

Mohammed (2007) used quarterly data from 1977:Q1 to 1998:Q2 and the error correction model and co-integration modelling techniques to examine the long run and short run relationship between Malaysian trade balance with real exchange rate, domestic income and world income. The author found evidence that devaluation of the ringgit improves the trade balance in the long run. Moreover, world income and domestic income were also found to be significant determinant of trade balance. The results furthermore indicated that devaluation of the domestic currency improves the trade balance in the short run and deteriorates the trade balance before improving it again. This suggests that there exists evidence of an unusual J-Curve effect, the 'delayed J-Curve effect'.

A recent study by Siklar and Kecili (2018) tested the fulfillment of the Marshall-Lerner condition and investigated the J-Curve effect for Turkey. This analysis was done by means of the VECM approach over a monthly data series from 2003:1 to 2016:12, the study found evidence that the M-L condition was met for Turkey. Further, the study revealed that depreciation of the Turkish lira worsens the trade balance in the very-short-run while improving the trade balance during transition from the short run to long run. Thus, the study concludes that the Turkish data presents an indication that is consistent with the J-Curve phenomenon. On the contrary, mixed results were

found in a study by Gan-Ochir (2018). By using quarterly time series data from 2000:Q1 to 2011:Q4, Gan-Ochir (2018) explored the effect of real exchange rate depreciation on trade balance in Mongolia. After adopting a vector error correction modelling technique, the author established evidence that devaluation of the exchange rate improves trade balance in both the short run and long run. The results suggest that the Marshall-Leaner condition holds while there is no support for the existence of the J-Curve effect in the Mongolian trade balance.

2.3.2 Disaggregated Country Level

Whereas some studies analyzed the long run and short run effect of real exchange rate on trade balance at aggregate level, other studies drew attention on disaggregating trade data from the traditional norms of trade between just one country and the rest of the world (ROW) to trade between one country and its main trading partners, Bahmani-Oskooee (1985) made a break through after advancing a method for testing the J-Curve effect. By examining the J-Curve effect for four Least Developed Countries (LDCs) namely: Greece, India, Korea and Thailand over annual data from 1973 to 1980. The results show evidence in support of the existence the J-Curve effect for all cases except for Thailand. On the other hand, Rose and Yallen (1989) employed disaggregated bilateral trade data, the results shows neither evidence supporting the existence of the J-Curve effect nor evidence of the long run relationship in the case of USA data for the period 1960 to 1985.

Furthermore, an earlier study by Bahmani-Oskooee and Goswami (2003) examined the short run and long run impact of real depreciation of the yen on the Japanese trade balance using bilateral data between Japan and its main trading partners such as: Australia, Canada, France, Germany, Italy, Netherlands, Switzerland, United Kingdom and United States of America. By using quarterly data for the sample period 1973:Q1 to 1998:Q4 and the bound test to cointegration. The study

found evidence in support of the J-Curve effect between Japan and Germany; and Japan and Italy. Moreover, real depreciation of the yen was found to have favorable effects in the long run only in three cases, namely; Canada, the UK and USA.

But, Bahmani-Oskooee, Goswami and Talukar (2005) failed to find any evidence in support of the J-Curve effect for Australia and its main (20) trading partners. By means of quarterly data from 1973:Q1 to 2001:Q4, the study adopted the bound test to co-integration and error correction modelling approach to investigate the short run and long run effects of devaluation on real exchange rate on Australia's trade balance with its main (23) trading partners.

Meanwhile, mixed results were obtained in an earlier study by Hsing (2008) who tested for the J-Curve effect on bilateral trade between the USA and seven Latin American Countries: Argentina, Brazil, Chile, Colombia, Ecuador, Peru and Uruguay by means of a vector error correction model over quarterly data. In this study, the sample period was different for each country with Chile having the longest sample period covering 1980:Q4 to 2017:Q3 while for the other six countries, the sample period ranged between 1991:Q1 to 2017:Q3. The study found evidence in support of the J-Curve effect for Chile, Ecuador and Uruguay and lack of support for the J-Curve effect for Argentina, Brazil, Colombia and Peru. Contrary to Hsing (2008), a study by Bahmani-Oskooee *et al* (2008) found evidence in support of the J-Curve effect for 11 out of 20 countries in the sample. The study employed quarterly trade data covering 1973:Q1 to 2001:Q2 and employed the bounds testing to co-integration and error correction modelling techniques to explore the J-Curve effect for Canada vis-a-vi its main (20) trading partners.

Halicioglu (2008) tested for the existence of the J-Curve effect between Turkey and its main trading partners using quarterly time series data from 1985:Q1 to 2005Q4. By means of the bounds testing to co-integration approach and the error correction model, the study failed to establish any

indication of the existence of the J-Curve effect, but found evidence that in the long run, devaluation of the Turkish lira has a positive impact on Turkish trade balance with the UK and USA, providing support in favor Marshall-Lerner condition.

Bahmani-Oskooee and Cheema (2009) employed desegregated data at bilateral level between Pakistan and its main (13) trading partners to determine if there is any partner whose trade balance react to changes in real bilateral exchange rate. The study engaged the bound testing to co-integration and Johansen's co-integration approach over quarterly data spanning from 1980:Q1 to 2003:Q4. The results of the bound test to co-integration showed evidence supporting the short run effects of real exchange rate on trade balance, but this was not consistent with the J-Curve effect. On the other hand, results of the Johansen's co-integration approach did not provide much support for both the short run and long run effects.

In a different study, Bahmani-Oskooee and Harvey (2009) used disaggregated quarterly trade data for the period 1974:Q1 to 2008:Q4 to investigate the short run and long run effect of real exchange rate on Indonesia's bilateral trade balance with each of its main trading partners (Australia, Canada, China, Hong Kong, Japan, Korea, Malaysia, New Zealand, Philippines, Saudi Arabia, Singapore, Thailand, USA and the UK). After employing ARDL and ECM, the results revealed that while in many cases devaluation of the rupiah have long run effects, the short-run effects lasts into the long run favorable effect only in Indonesia's trade balance with Canada, Japan, Malaysia, Singapore and the UK.

In South Africa, conflicting results were observed after Moodley (2010) carried out a study to examine the J-Curve hypothesis on South Africa's bilateral trade with BRIC countries (Brazil, Russia, India, and China) over the period 1994Q:1 to 2009:Q4. By adopting the ARDL approach, the study found mixed results, in the case of Brazil and India, the real exchange rate has a negative

impact while for Russia and China it was found to have a positive impact. Finally, the author established that devaluation does not necessarily lead to a long term improvement of the trade balance and no evidence of the J-Curve was found.

Similar conclusions to that of Bahmani-Oskooee (1985) were observed in a study by Ping (2012) after examining the short run and long run relationship between exchange rate and trade balance for three Indo-China countries (Cambodia, Thailand and Vietnam) for the period 1994:Q1 to 2010:Q4 on a quarterly basis. By means of the ARDL and Granger causality test, the study revealed no evidence in support of the long run relationship between exchange rate and trade balance for all three countries. These results are consistent to Bahmani-Oskooee (1985) study who failed to find evidence in support of the long run relationship following devaluation. On the other hand, Ping (2012) found evidence supporting the short-run relationship (J-Curve effect) for all three countries including Thailand which according to Bahmani-Oskooee (1985) study failed to find evidence in support of the J-Curve effect.

Salmasi (2013) investigates the short and long run effects of exchange rate on trade balance by employing the bound test to co-integration approach applied to quarterly data for 2001:Q1 to 2011:Q4. The results obtained showed that the hypothesis that devaluation positively affect trade balance in the long run. Furthermore, the results show that devaluation negatively impact on trade balance in the short run, hence confirming the existence of the J-Curve effect.

Šimáková (2014) investigated the J-Curve effect in the bilateral trade flows between Hungary and its major trading partners (Germany, Austria, Italy, France, the Netherlands, the UK, Poland and the Czech Republic) using quarterly trade data for the period 1997:Q4 to 2012:Q4. To analyze the long run effect between variable, the Johansen co-integration test was employed while the short run effect and the related J-Curve effects was estimated with the error correction model and

evaluating the impulse response functions. Subsequently, results suggest that a typical J-Curve effect was found to exist in the bilateral trade flows with the United Kingdom while in trade flows with Austria and Italy, a partial J-Curve was observed. On the hand, an inverse J-Curve effect was discovered in the bilateral trade with the Czech Republic.

In another study, Yazici and Baba (2016) were unsuccessful in detecting at aggregate level the J-Curve effect and the M-L condition between Nigeria and its largest EU trading partners, the EU15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden and the U.K) for the period 1999:Q1-2012:Q4 after employing the auto regressive distributive lag approach. But on a bilateral level, the evidence of the J-Curve effect was established in four cases, with Austria, Denmark, Germany and Italy whereas the M-L condition was only found to hold in the case of Luxemburg.

Meanwhile, a study by Aketey (2016) found evidence in support of the M-L condition in many cases for Ghana and its main trading partners. The study used annual data for the period 1996 to 2013 to investigate the existence of the Marshall Lerner condition in Ghana, using bilateral trade between Ghana and China, India, Netherlands and South Africa. By means of the fully modified ordinary least squares (FMOLS) to correct for serial correlation and endogeneity effects due to co-integration relationships amongst variables. The results suggest evidence for the existence of the M-L condition when Ghana traded with China, India, Netherlands and South Africa on a bilateral level. Further, it was established that Ghana could use devaluation as a policy tool to improve its trade balance by implementing country specific bilateral policies.

2.3.3 Sector and Commodity Level

In the midst of studies that used disaggregated trade data beyond country level to focus more on industry and or product level. Baek, Mulik and Koo (2006) employed quarterly data for the period 1989:Q1 to 2004:Q4 to examine the J-Curve effect for USA agriculture trade and compare the effect to USA non agriculture trade between US and its main trading partners (Japan, Canada and Mexico). The study adopted ARDL approach and revealed very little evidence of the J-Curve effect in the case of USA agriculture trade with all trading partners. On the other hand, the study revealed evidence of the J-Curve effect in the case of USA non agriculture trade with Japan and Canada, but not in the case of Mexico.

Bahmani-Oskooee and Kovyryalova (2008) used yearly industry based data from 177 industries that traded between the USA and the UK from 1962 to 2003 to assess the short run and long run effects of changes in real exchange rate on UK's trade balance. The study employed ARDL approach and ECM and found 107 of the 177 industries trade balance responded to devaluation of the pound in the short run. The study further concludes that the short run effect lasts into the long run only for 66 industries, supporting what they termed "a new definition of the J-Curve effect" Bahmani-Oskooee and Kovyryalova (2008:35).

In another study, Bahmani-Oskooee and Mitra (2009) established that devaluation will hurt other industries in the long run. Industry trade data between India and USA for 38 industries was used over annual data from 1962 to 2006. By applying the bounds testing to co-integration approach and the error correction model with the aim of identifying the industries that respond favorably to depreciation of the rupee and those that do not. The study revealed evidence in support of the J-Curve for at least eight industries while the long run results reveals that there are six industries that will be hurt by devaluation in the long run. The study confirm that while past studies that used

aggregated trade data in India failed to establish the J-Curve effect, it was established upon disaggregating trade data.

Another study by Abd-El-Kader (2013) examined whether the J-Curve effect was observable for Egypt vis-à-vis its main trading partners (Algeria, Brazil, Canada, China, Denmark, France, Germany, Greece, India, Italy, Japan, Jordan, Morocco, Sudan, Saudi, Spain, Turkey, Syria, UK, USA). The study engaged the ARDL bound testing procedure estimated by FGLS, pooled mean group (PMG) and dynamic fixed effects (DFE) models for a panel data for Egypt vis-à-vis its main trading partners over a sample period 1989 to 2010. The study found that real exchange rate variations explain a substantial part of the changes in Egypt's trade balance. The results indicate that in the short run, currency depreciation deteriorates the trade balance, but improves it in the long run. These findings are consistent with J-Curve effect and the M-L condition in Egypt's case.

Hussain and Haque (2014) echoed similar sentiment as Abd-El-Kader (2013) after examining the relationship between official exchange rate and trade balance on the basis of the J-Curve hypothesis. The author applied both fixed and random effect models over a panel of 49 developing countries from Africa and found evidence in support of the J-Curve hypothesis. Therefore, the study established that countries can improve their current account balance by depreciating their currency. This is in line with what economic theory suggest.

On his part, Vural (2015) applied the ARDL and error correction model over monthly data for the period 2002:1 to 2014:12 and subsequently found no evidence of a single pattern of the exchange rate - trade balance relationship. Vural (2015) explored the relationship between real exchange rate and trade balance between Turkey and Germany at industry level and found results in support for the existence of the J-Curve effect in 20 out of 96 industries. In line with traditional wisdom of

exchange rate theory, for 54 industries the exchange rate coefficient was found to be negative and statistically significant, implying that the long-run effect of a real depreciation is positive for these industries.

Ţuţueanu (2015) scrutinized the J-Curve hypothesis on forestry products for Romania, that is, whether the trade balance for Romanian forest products benefits from devaluation of the Romanian currency (leu). The study espoused the bounds testing approach to co-integration and error correction modelling approach to estimate annual bilateral trade data of Romanian forest products from 1991 to 2013 with various countries in the world. The results showed no evidence of the J-Curve effect for the trade in Romanian forest products. Further, the long run analysis revealed that exchange rate is insignificant in influencing the trade balance.

Bahmani-Oskooee and Durmaz (2016) went beyond disaggregating trade data to industry level in order to reduce aggregation bias. In this study, the authors employed new advanced techniques of asymmetric co-integration and error correction modelling techniques. These approaches which introduces nonlinear adjustments of exchange rate yields results that differ from linear models. These techniques were applied to 57 industries that trade between Turkey and the EU over monthly data for the period 1995:1 to 2014:12. The results showed evidence of asymmetric effects in the short run for all industries, short run adjustment asymmetry in 24 industries, short run impact asymmetry in 17 industries and long run asymmetric effects in 23 industries. The authors then concluded that the size of the industry did not matter as both small and large industries are subjected to the same asymmetric effects.

2.3.4 Overview of reviewed empirical literature

Most empirical literature reviewed in this study have used acceptable longer time series in the analysis, for instance Bahmani-Oskooee, Goswami and Talukar (2005) engaged quarterly data from 1973-2001, Bahmani-Oskooee and Kovyryalova (2008) employed data spanning from 1962-2003, Hsing (2008) used data from 1980Q1-2017:Q4, Bahmani-Oskooee and Mitra employed data for the period 1962-2006, while in another study Bahmani-Oskooee and Harvey used data for the period 1974Q1-2008:Q4 and data for the period 1980-2003 was used in a study by Bahmani-Oskooee and Cheema (2009). In the case of a few studies that appeared to have used shorter time series, sufficient justifications was provided and in many instances the data was disaggregated to monthly or quarterly. Furthermore, appropriate econometrics models best suitable for short time series e.g. the ARDL, ECM approach was used in the analysis.

The bound test to co-integration (ARDL), error correction model was religiously used by many studies reviewed in the present literature. This model is sufficiently supported by a wide body of literature on the subject since it was first introduced by Bahmani-Oskooee (1985). However, a few selected studies used different models for instance, Add-EL-Kader (2013) and Hussain and Haque (2014) employed panel data analysis. Additionally, models such as reparation analysis, simultaneous equations, co-integration ARDL response function, and Johansen cointegration and response function and co-integration VECM approach. Subsequently, the overall findings from these studies are of a mixed nature i.e. some studies established the M-L Condition and the J-Curve effect. Other studies found no evidence in support of this relationship. Further, in some studies the J-Curve effect was established whereas the M-L Condition was not met and in some studies these findings were vice versa. It seems the theories on this relationship has been exaggerated.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter commences by highlighting the design of the study. This is followed by a discussion on the econometric model employed to investigate the impact of real exchange rate on trade balance, focusing on Namibia and its major trading partners. Furthermore, this chapter outlines the model specifications and econometric framework, the data sources and estimation procedures, methods of data analysis, stationarity tests, the bound test to co-integration (ARDL), error correction model, and finally the diagnostic tests performed on the model to ascertain various checks and balances. Overall, this chapter discusses the methodology employed to achieve the objectives of this study.

3.2 Research Design

The design of this study is of a quantitative nature. The study adopted a similar definition of trade balance as Bahmani-Oskooee and Goswami (2003) who defined bilateral trade balance as a ratio of merchandize exports over merchandize imports. Namibia's real GDP was used as a proxy for real national income; the real GDP of Namibia's main trading partners was used as a proxy for real income of Namibia's main trading partners. The real exchange rate was calculated based on a formula provided by Abel and Bernanke (2005) as cited in Chiloane (2013) which is given as the nominal bilateral exchange rate between domestic currency and the currency of the main trading partner multiplied by the ratio of foreign consumer price index to domestic consumer price index.

3.3 Model Specification and Econometric Framework

This study adopted the model used by Šimáková (2013) in the estimation of the J-Curve effect in the bilateral trade between Hungary and its major trading partners. The model was estimated by

means of the bound test (ARDL co-integration) procedure. The application of ARDL to test the J-Curve effect has been sufficiently supported by a wide body of literature since it was first used by Bahmani-Oskooee in 1985. The model is applicable for both non-stationary time series as well as for time series with mixed order of integration. Furthermore, it can be applied to a short time series data, as is the case in this study, and still yield the best results. Additionally, ARDL have the ability to estimate both the short run and long run dynamics of the estimates simultaneously. Majority of studies in the present empirical literature have predominantly followed the ARDL. Based on theory, a country's trade balance performance can be captured by a general reduced form equation directly depending on real exchange rate (RER_t), real domestic income Y^d, real foreign income (Y^f). Consequently, from a theoretical basis, Rose and Yellen (1989) specified this relationship in a simple mathematical expression:

$$TB = f\left(Y_t^d,\ Y_t^f,\ RER_t\right) \tag{3.1}$$

Where; TB is a measure of real trade balance, defined as a ratio of Namibia's exports to imports against all the main trading partners and denotes the dependent variable.

The reduced form equation in (3.1) is linear in nature, and hence, can further be expanded into a log-linear specification of the model to include the intercept and an error term as specified below:

$$\ln TB_t = \alpha + \beta lnY_t^d + \gamma lnY_t^f + \delta lnRER_t + \varepsilon_t \tag{3.2}$$

Equation (3.2) is a theoretical derivation of the reduced form and can be found in Rose and Yallen (1989). Where: *L*n represents respective natural logarithm of the variables as defined above, α is the intercept while $\beta, \gamma\ and\ \delta$ are respective coefficients of the explanatory variables and the subscript t is the time aspect whilst ε is the error term which takes account of the effects of all the

other factors (variables) affecting trade balance, but were excluded from the model e.g. money supply.

While authors such as Halicioglu (2008), Musawa (2014), Ogutu (2014), Eke *et al* (2015), Khan (2016) and Dar (2016) have expectations about the signs of the coefficient in equation (3.2), some authors, for instance Matlasedi (2015), Musawa (2014), Ziramba and Chifamba (2014), Chiloane (2013) and Halicioglu (2008) have no prior expectations of the signs of β and γ due to their empirical nature. For example, it is expected that an estimate of β would be positive because an increase in the country's national income usually leads to a rise of imports from its trading partners. However, if an increase in domestic income is due to an increase in the production of import substitute goods, the country may import less as its economy grows, yielding a negative estimate for β. Therefore, β could be negative or positive depending on whether demand side factors dominate supply side or vice versa. By the same token, the estimated value of γ could be either positive or negative. Hence, different authors will have different preferences given that these coefficients can assume any sign.

3.4 Definition of variables and sign expectations

This subsection outlines and defines the variables that are used in the empirical model of equation (3.2). During the discussion on previous research done on the subject of exchange rate and the trade balance, it emerged from the literature that the real exchange rate, domestic and foreign income are the three main determinants of the trade balance. Hence, guided by literature, the current study uses the real exchange rate, real domestic income and real foreign income as determinants of Namibia's bilateral trade balance with its main trading partners. The prices of both imports and exports depend on prevailing exchange rate during a particular period, hence the importance of real exchange rate as a determinant of trade balance. In order to import goods from

abroad, a country needs to earn an income, thus, domestic income also becomes vital as a determinant of trade balance. By the same token, a country's export depends on the ability of foreign national to generate income that they will use to acquire imports from the domestic country, rendering foreign income a vital determinant for trade balance. These factors according to Khan and Hossain as cited in Chiloane (2013) capture the element of the exchange rate to the balance of payment approach while the element of the absorption approach are embedded in both domestic and foreign income. Finally, the exchange rate as an independent variable captures element of the elasticity approach.

Trade balance

Trade balance herein is measured as the ratio of Namibia's real exports to real imports from its main trading partners. This definition of trade balance has been widely used in literature, for instance in the work of Bahmani-Oskooee (1985), Rose and Yallen (1989), Bahmani-Oskooee (2008), Musawa (2014), Matlasedi *et al* (2015), Dar (2016). As pointed by Onakoya, Johnson and Ajibola (2018), the trade ratio (exports divided by imports) is a better measure than the trade balance defined as exports minus imports. It is transformed into a ratio because of the frequency of trade deficits experienced by a country such as Namibia compared to very few instances in which the country recorded a trade surplus. More so, Matlasedi *et al* (2015) submitted that the trade ratio is capable of being logged regardless of whether a trade balance is a surplus or a deficit.

Real exchange rate

Real exchange rate measures the value of a country's goods against those of another country at a prevailing nominal bilateral exchange rate. It is expected to be positive if devaluation is to increase exports and lower imports in the long run, which happens to satisfy the M-L condition. However,

according to the J-Curve phenomenon, it is expected that δ should be negative at lower lags followed by positive at higher lags in the short run. The real exchange rate can be expressed in the following way;

$$RER = NER\left(\frac{P_f}{P_d}\right)$$

Where NER is nominal bilateral exchange rate defined as the number of domestic currency (Namibian dollar) required to purchase a unit of a foreign currency, P_f is the average price level (CPI) of goods in the foreign country (i.e. of the main trading partners) and P_d is the average domestic price level (CPI).

Real domestic income

Real domestic income or Namibia's real income is represented by real GPD of Namibia. According to Halicioglu (2008) it is expected to be positive since an increase in real domestic income is usually accompanied by a rise in imports from the domestic country's trading partners, which in turn worsens the trade balance. Nonetheless, if the increase in domestic income emanates from increased domestic production of import substitute goods, the domestic country may reduce its imports due to economic growth resulting in an estimate of real domestic income to be negative. Hence, Halicioglu (2008) argues that real domestic income can assume any sign depending on whether demand factor side dominates supply side, the opposite also holds.

Real foreign income

The real GDP of Namibia's main trading partners is used as a proxy for foreign income. These trading partners are Angola, Botswana, China, Spain, Germany, Italy, UK, USA, South Africa and

Switzerland. Similar to the sign expectation of real domestic income, the estimated value of real foreign income could also be positive or negative.

3.5 Data Sources and Estimation Procedures

Quarterly macroeconomic time series data based on literature, spanning from 1998:Q1 to 2018:Q4 was used. The variables comprised of the trade balance (TB), real domestic income (Y^d), real income of trading partners (Y^f) and real exchange rate (RER). Following Musawa (2014), real exchange rate data was interpolated from monthly data using Eviews 9.0, an econometric package under the assumption of quadratic match average. All series were converted to natural logs, according to Musawa (2014) and Fatukasi, Olorunlenke, Olajide and Alimi (2015) this is mainly due to two reasons namely (a) natural logs of a series effectively linearizes the exponential trend (in case of any) in the data series-since the log function is the inverse of an exponential function and (b) logs prevent the trouble in the modelling and inference and it allows the regression coefficient interpreted as elasticities.

The series were mainly obtained from sites and portals of various institutions such as the Bank of Namibia, South African Reserve Bank, World Development Indicator (WDI), and the Namibia Statistics Agency. Annual and quarterly reports from these institutions also formed part of a great source of data as well as past journal research papers covering similar topics.

The selection of countries was based on the share of Namibia's total international trade turnover. Average shares of selected trading partners for the entire sample period 1998 to 2018 is reported in Table 2.

Table 2: Namibia's average shares in international trade (1998-2018)

Trading partner	Share on total export	Share on total imports	Share on total trade turnover
South Africa	24.4	67.2	49.7
UK	12.0	2.0	6.1
Botswana	9.6	2.4	5.3
China	3.4	3.5	3.5
Switzerland	4.0	2.5	3.1
Angola	7.4	0.1	3.1
Spain	6.5	0.7	3.1
USA	4.1	1.5	2.6
Italy	3.7	0.9	2.0
Germany	1.5	2.2	1.9

Source: Trade Statistics, Namibia Statistics

The methodology involved regressing trade balance on the explanatory variables through the procedure in the following sequence: As a norm, the first step is to test for non-stationarity (unit root) using ADF and KPSS tests, optimal lag selection, bound test to cointegration (ARDL) to check for the existence of a long run relationship between the variables and in assessing whether a causal relationship exist between the variables. Moreover, the ARDL specification was re-parameterization into an error correction model (ECM), and finally, the models were subjected to various stability tests including validations of the model through the aid of a CUSUM and CUSUMQ tests.

3.6 Data Analysis Methods

Most time series are not stationary in nature as originally thought, different time series may possess different statistical properties (Nkoro & Uko, 2016). This entails a possibility that the mean and variance of the series vary systematically over time. When time series diverge from their mean and variance over time they are said to be non-stationary or that they contain a unit root. Regressing of such time series data yields spurious (nonsensical) results (Sheefeni & Nyambe, 2016). In an

effort to overcome this short coming, Pesaran and Shin (1999) initiated the ARDL also known as bounds test to co-integration, further developed by Pesaran, Shin and Smith (2001).

The bounds testing to co-integration have received tremendous attention compared to other tests due to its powerful nature of detecting the presence of a steady state equilibrium between variables (Sheefeni & Nyambe, 2016). Additionally, Nkoro and Uko (2016) contend that co-integration have become a prevalent requirement for most econometric models using non-stationary data. Therefore, the present study follows ARDL approach, mostly due to its advantages as pointed by authors such as Fatima et al, (2013), Sheefeni and Nyambe (2016) and Nkoro and Uko (2016).

Firstly, endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger (1987) method are avoided. Secondly, the long and short-run parameters of the model in question are estimated simultaneously. Thirdly, the bound test procedure does not require pre-testing for unit root and is relieved of the burden of establishing the order of integration amongst the variables in the model. However, the ARDL approach is applicable irrespective of whether the explanatory variables in the model are I(0) or I(1) or a mix of both. Nevertheless, Sheefeni and Nyambe (2016) stress that the approach will crash under variables of I(2) or higher. Finally, the small sample properties of the bounds testing approach are far superior to that of multivariate co-integration, as argued by Narayan (2005).

3.6.1 Unit Root Tests

Before any regression is performed, the first step in the ARDL approach was to investigate the time series properties of the data in order to establish if the data set is integrated or not (Paavo, 2017). Although many authors believe that the ARDL bound test does not require pretesting for unit root, this study begins by testing the data series for unit root to insure that none of the variables

are integrated at I(2) or higher as alluded by Ahmed, Muzib and Roy (2013).The study employed Augmented-Dickey Fuller (ADF) test for which the null hypothesis is non-stationarity and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test for which the null hypothesis is stationarity to determine the maximum order of integration.

Various measures of unit root have been developed such as the modified Dickey Fuller (DF) test, based on generalized least squares (GLS) detrending series also known as DF-GLS test and the Ng and Peron test for unit root. The most popular one according to Alimi and Ofonyelu (2013) is the KPSS developed by Kwiatkowski, Phillips, Schmidt and Shin (1992). This test can be seen as a complement to other unit root tests such as the ADF. Alimi and Ofonyelu (2013) argue that in order to distinguish between series that appear to be stationary, series that appear to have unit root and series for which the data (or tests) are ambiguous, is to test both the unit root hypothesis and the stationarity hypothesis. Joint testing of both null hypotheses can strengthen inferences made about stationarity or non-stationarity of a time series especially when the outcomes of the two null hypotheses support each other, Alimi and Ofonyelu (2013) have termed this test "the confirmatory analysis". For instance, when the null of stationarity is not rejected and the null of non-stationarity is rejected, there is a confirmation that the series is stationary. On the other hand when the null of stationarity is rejected and the null of non-stationarity is not rejected, the series confirms non-stationarity. The major disadvantage for the KPSS test is that it has a high rate of type I error i.e. it tends to reject the null hypothesis too often, hence the suggestion by Alimi and Ofonyelu (2013) to combine the KPSS with the ADF test because if the results from both tests suggests that the time series is stationary, then it probably is stationary.

3.6.2 Determination of Optimal lags

After the determination of the univariate characteristics of the variables and their order of integration, the next step of the procedure is anticipated to establish the optimal lag length of the models. If a long run relationship exist between the underlying variable, while the hypothesis of no long run relationships between variables in the other equation cannot be rejected, then the ARDL approach to co-integration can be applied (Nkoro & Uko, 2016). The determination of the optimal lag length for each of the underlying variables in the ARDL model is very important as it is recommended to have the Gaussian error terms (i.e. standard normal error term that do not suffer from non-normality, autocorrelation heteroskedasticity etc.).

In order to select the appropriate model underlying equation, it is apparent to determine the optimum lag length (k) by using proper model order selection criteria such as Akaike's Information Criterion (AIC), Schwarz-Bayesian Criterion (SBC), Final Prediction Error (FPE), Hannan-Quinn Information criterion (HQ) and the Likelihood Ratio (LR). Among these criterion, researchers such as Paavo (2018); Sheefeni and Nyambe (2016) suggested that the SBC and HQ are generally used due to their powerfulness and consistence. Nevertheless, the current study adopts Eview-9 which automatically selects the model by evaluating different models.

3.6.3 ARDL Co-integration tests

Once the foregoing is achieved, the next step is to test for co-integration. Co-integration is defined as the long term or equilibrium relationship between two or more variables (Nkoro & Uko, 2016). Further, co-integration exists when variables are individually non-stationary but a linear

combination of them is found to be stationary, such that there is a long run relationship between such variables Chiloane (2013). Thus, according to Nkoro and Uko (2016) co-integration is an ideal analysis technique for the determination of the existence of a long run relationship among the variables shown in equation (3.2) which summaries the long run relationship between bilateral trade balance, a dependent variable and all the explanatory variables such as real domestic income, real foreign income and real interest rate.

The determination of the impact of real exchange rate on bilateral trade balance will only be meaningful if these variables have a long run relationship so that the variables do not drift away from each other over time Chiloane (2013). The bound test to co-integration as asserted by Nkoro and Uko (2016) is mostly preferred over traditional co-integration approaches such as Granger (1981), Engle and Granger (1987) and the Johansen and Juselius (1990); Philips and Hansen (1990); and Johansen (1991); Johansen (1992) maximum likelihood ration in economic literature. The bound testing approach is favoured based on the fact that both the short run and long run parameters of the model specified can be estimated simultaneously.

In this study, the bound test (autoregressive distributive lag, ARDL) approach introduced by Pesaran *et al* (2001) is applied in examining the existence or lack of a long run relationship among the variables. The test involves an estimation of an unrestricted error correction model (UECM) of equation (3.3) that consists both the short run and long run dynamics.

$$\Delta LnTB_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta LnTB_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\, \Delta LnY^d_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta LnY^f_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\, \Delta LnRER_{t-i}$$

$$+ \theta_1 LnTB_{t-1} + \theta_2 LnY^d_{t-1} + \theta_3 LnY^f_{t-1} + \theta_4 LnRER_{t-1} + \epsilon_t$$

$\ldots\ldots\ldots\ldots\ldots\ldots Equation$: (3.3)

Where; Δ is the first difference operator,ϵ is the error term assumed to be the white noise with other variables still as defined in equation (3.2). The second part of the equation (θ_1-θ_4) on the right hand side of the equation represent the estimated long run coefficients whereas the first part of the equation (α_{1i}-α_{4i}) refers to the short run coefficient.

The Wald-test was conducted for the joint significance of the coefficient of the lagged levels of variables i.e., the null and alternative hypothesis. The most important part of equation (3.3) is to test the null hypothesis of no co-integration among variables under the condition specified below:

$H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (Null, i.e. no long run relationship);

Against the alternative hypothesis:

$H_1: \theta_1 \neq 0 \; or \; \theta_2 \neq 0 \; or \; \theta_3 \neq 0 \; or \; \theta_4 \neq 0$ (Alternative, i.e. there is a long run relationship)

If the null hypothesis is not rejected it means that there is no co-integration whereas if the null hypothesis is rejected, it indicates that the variables in the equation are co-integrated. According to Stučka (2004) since the asymptotic distribution of the F-test and the Wald-test is not standard, two sets of critical bounds have been provided by Pesaran, Shin and Smith (1996). One set assumes all variables are I(0) and the other set suggests that all variables are I(1). However, these sets of critical values were developed from a sample size of 500 and 1000 observations and 20 000 and 40 000 replications, respectively. Narayan (2005) opposed the use of such critical values as they cannot be used for small sample size such as the one in the present study. Hence, the current study employed the Wald test and used the Chi-square statistics to determine the existence or lack of the long run relationship among the variables. The P-value was then considered when applying the Chi-square statistic. It is anticipated that the P-value of the Chi-square statistics must be 10% or less in order to reject the null hypothesis of no co-integration or long run relationship among the

variables. On the other hand, the null hypothesis cannot be rejected if the P-value happens to be more than 10%, it is rather accepted and then conclude that there is no long run relationship among the variables.

3.6.4 Long run analysis

If the ARDL bound test to co-integration provides sufficient evidence of a long run relationship between bilateral trade balance and real domestic income, real foreign income and real exchange rate, the next step in the procedure is to proceed with an estimation of the long run co-integrating equation and the coefficients of the model specified Eita (2018). In this model, the long run impact of real exchange rate devaluation on bilateral trade balance is described by the Marshall-Lerner condition which states that devaluation of the real exchange rate improves the trade balance in the long run. Subsequently, the long run equation specified in equation (3.5) was estimated using ARDL to get the coefficient of the explanatory variables.

$$LnTB_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, LnTB_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\, LnY_{t-i}^{d} + \sum_{i=0}^{n} \alpha_{3i}\, LnY_{t-i}^{f} + \sum_{i=0}^{n} \alpha_{4i}\, LnRER_{t-i} + \epsilon_t$$

…… $Equation$ (3.5)

The coefficient of $LNRER$ shows whether the M-L condition is met or not as asserted by Ziramba and Chifamba (2014). Therefore, the M-L condition is satisfied whenever α_{4i} are positive, indicating that higher real exchange rate, that is a real depreciation, appears to improve the trade balance over time.

The primary concern of the current study is to estimate the time-path of bilateral trade balance response to changes in real exchange rate of the domestic currency. Hence, Nkoro and Uko (2016)

asserts the essence of estimating the short run equation in order to capture the speed of adjustment. Subsequently, analysis of the short run is discussed in the succeeding section.

3.6.5 Short run model

The J-Curve effect is described as a short run analysis, hence to test the J-Curve effect a short run analysis is required. The short run effects are captured by the coefficients of the first-differenced variables of the reparametrized unrestricted error correction model (UECM) in equation (3.3).Therefore, following Waliullah, Kakar, Kakar and Khan (2010), the UECM was re-modified and specified into a restricted error correction model to yield:

$$\Delta LnTB_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta LnTB_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\, \Delta LnY^{d}_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta LnY^{f}_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\, \Delta LnRER_{t-i} + \Omega EC_{t-1} + \epsilon_t$$

$\ldots\ldots\ldots\ldots\ldots\ldots Equation: (3.6)$

Where: Ω is the speed of parameter adjustment and EC, is the residual obtained from the estimated cointegrating equation (3.2) as stated earlier.

According to Waliullah *et al* (2010) estimation of the error correction model (ECM) is essential in determining the short-run dynamics of the coefficients associated with the long run relationship and indicates the speed of adjustments back to the long run equilibrium after a short run disturbance. However, according to Nkoro and Uko (2016) this estimation is not possible without the existence of a long run relationship among the variables. Upon determining the existence of a long run relationship among the variables in the model (co-integration), the next step involves estimating the long run equation (3.6) which contains the lagged residuals obtained when

estimating the co-integrating equation. It is calculated from the lagged linear combination included in the UECM equation (3.3) over time and is denoted by EC_{t-1}. It is then replaced by the linear combination of the lagged level variables by EC_{t-1} and re-estimated the model for each case. The coefficient of the residual is expected to be negative, statistically significant and less than unity, implying that the variables are indeed co-integrated (Musawa, 2014).

3.5.6 Diagnostic Tests

The existence of co-integration derived from equation (3.3) does not necessarily imply that the estimated coefficients are stable (Bahmani-Oskooee & Brooks, 1999). Hence, the model was subjected to various tests of robustness. These tests, according to Paavo (2017) and Sheefeni and Nyambe (2016) include serial correlation which was tested by the Breusch-Godfrey LM test, heteroscedasticity amongst residuals tried by Breusch-Pagan-Godfrey and ARCH tests. The Ramset test was used to test for model specification, whereas normality test was tried by the Jarque-Bera test. Finally, model stability tests developed by Brown et al (1975), known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests bases on a recursive regression residual were also performed on the model. The CUSUM and CUSUMSQ statistics are recursively updated and plotted against the break points of the model. In order to confirm stability of the coefficients in a given regression model, the plots of the two statistics must fall within the critical bounds of 5% significance. These tests were implemented by means of graphical representation.

CHAPTER FOUR: EMPIRICAL ANALYSIS

4.1 Introduction

This chapter discusses the results from various tests conducted, starting with the unit root test for the determination of stationarity and establishment of order of co-integration on a partial basis. A discussion of optimal lag length proceeds to establish the optimal lags. Further, results from the ARDL bound test are presented to confirm the long run relationship among the variables. Subsequently, results of the long run and short run model are discussed and finally the results of the diagnostic tests of the models are presented.

4.2 Unit root test

As indicated earlier, ARDL approach does not require pretesting of the time series for unit root, however, to proceed with ARDL one must ensure that the time series adhere to the condition of an ARDL estimation which requires a mix of I(0) and I(1) but not I(2) or higher (Sheefeni & Nyambe, 2016). Hence, pretesting for unit root is required to ascertain the number of times a variable/series has to be different to achieve stationarity subsequently leading to the determination of integration. A variable Y is said to be integrated of d, I(d), if it attained stationary after differencing d times (Nkoro & Uko, 2016).

Various tests have been devised to check for stationarity of time series data, this study investigated the univariate characteristics of the series using augmented dickey-fuller and Philips-Perron tests. Additionally, the Kwiatkowski-Philips-Schmidt-Shin test whose results are represented in annexure table was employed as a confirmatory test for the ADF and the results of the KPSS. Table 3 shows results from the ADF and PP in level and at first difference. The results show that most variables (domestic and foreign GDP) are non-stationary in level but become stationary after being differenced ones. However, the GDP of Italy is stationary in level while that of Spain is

none-stationary even after first difference and only become stationary after differencing twice. But it becomes stationary at first difference according to KPSS results. Namibia's trade balance against five out of its ten trading partners (Angola, Botswana, Italy, Switzerland and Germany) is stationary in levels while the trade balance with the remaining five trading partners (China, Spain, South Africa, UK and US) became stationary only after first difference. Finally, only the real exchange rate between NAD/Kwanza and NAD/EUR were stationary in level, the rest became stationary after differencing once. As shown in Table 3, it can be confirmed that there exist a mixture of the different order of integration i.e. I(0) and I(1), hence the procedure to estimate ARDL can proceed Nkoro and Uko (2016).

Table 3: Unit root test: ADF and PP in levels and first difference

Variable	**ADF**		**PP**		**Order of integration**
	Level	**1st difference**	**Level**	**1st difference**	
lnY					
Angola	-0.057 (-2.587)	-9.440 (-2.586)***	0.057 (-2.586)	-9.470 (-2.587)***	I(1)
Botswana	-1.089 (-2.587)	-2.730 (-3.587)**	-1.956 (-2.586)	-10.908 (-3.586)***	I(1)
China	-1.391 (-2.587)	-0.714 (-2.589)	-0.733 (-2.586)	-12.101 (-3.512)***	I(1)
Germany	-0.679 (-2.586)	-5.850 (-3.512)***	-0.378 (-2.586)	-5.896 (-3.512)***	I(1)
Italy	-2.696 (-2.586)*	-4.124 (-2.586)***	-2.367 (-2.586)	-4.201 (-3.512)***	I(0)
South Africa	-2.148 (-2.586)	-4.862 (-3.512)***	-2.123 (-2.586)	-4.784 (-3.512)***	I(1)
Spain	-1.392 (-2.589)	-1.953 (-2.587)	-2.140 (-2.586)	-2.140 (-2.586)	I(2)
Switzerland	-0.409 (-2.586)	-5.454 (-3.512)***	-0.629 (-2.586)	-5.507 (-3.512)***	I(1)
UK	-1.456 (-2.586)	-4.273 (-3.514)***	-1.731 (-2.586)	-4.262 (-3.512)***	I(1)
USA	-1.347 (-2.586)	-6.079 (-3.512)***	-1.471 (-2.586)	-6.151 (-3.512)***	I(1)

Namibia	-1.359 (-2.587)	-3.238 (-2.899)**	-1.385 (-2.586)	-9.529 (-3,512)***	I(1)
lnTB					
Angola	-2.988 (-2.897)**	-9.620 (-3.523)***	-4.842 (-3.511)***	-20.030 (-3.515)***	I(0)
Botswana	-4.446 (-3.512)***	-8.432 (3.523)***	-4.299 (-3.511)***	-16.353 (-3.512)***	I(0)
China	-2.186 (-2.586)	-9.495 (-3.514)***	-6.861 (-3.511)***	-24.852 (-3.512)***	I(1)
Germany	-2.661 (-3.514)*	-8.421 (-3.514)***	-6.710 (-3.511)***	-30.645 (-3.511)***	I(0)
Italy	-4.744 (-3.511)***	-6.463 (-3.517)***	-4.650 (-3.512)***	-23.370 (-3.512)***	I(0)
South Africa	-2.469 (-2.586)	-16.644 (3.512)***	-4.510 (-3.511)***	-20.970 (-3.512)***	I(1)
Spain	-2.216 (-2.586)	-5.904 (-3.519)***	-6.778 (-3.511)***	-33.362 (-3.512)***	I(1)
Switzerland	-4.199 (-3.511)***	-5.537 (-3.517)***	-4.129 (-3.511)***	-14.670 (-3.512)***	I(0)
UK	-1.720 (-2.586)	-15.454 (-3.512)***	-2.842 (-3.586)*	-17.137 (-3.512)***	I(1)
USA	-1.686 (-2.586)	-10.764 (-3.514)***	-6.192 (-3.511)***	-29.124 (-3.512)***	I(1)
lnRER					
NAD/Kwa	-3.126 (-2.820)**	-11.752 (-3.512)***	-3.573 (-3.513)***	-11.525 (-3.516)***	I(0)
NAD/Pula	-2.130 (-2.586)	-8.717 (-3.512)***	-2.130 (-2.586)	-8.717 (-3.512)***	I(1)
NAD/Yuan	-2.167 (-2.586)	-8.123 (-3.512)***	-2.167 (-2.586)	-8.130 (-3.512)***	I(1)
NAD/Eur	-2.718 (-3.518)*	-8.046 (-3.517)***	-2.265 (-2.586)	-8.051 (-3.517)***	I(0)
South Africa	-2.094 (-2.586)	-9.107 (-3.512)***	-2.094 (-2.586)	-9.107 (-3.512)***	I(1)
NAD/GBP	-1.591 (-2.586)	-9.554 (-3.512)***	-1.565 (-2.586)	-9.554 (-3.512)***	I(1)
NAD/USD	-0.939 (-2.587)	-4.511 (-3.514)***	-1.084 (-2.586)	-7.641 (-3.512)***	I(1)

Source: Authors' compilation and estimated values obtained from Eviews

*Notes: (a) *** (**) and * implies rejection of the null hypothesis at 1%, 5% and 10% respectively.*

4.3 Optimal lag model selection

The ARDL models were selected at optimum lag with lowest values of AIC and SIC criteria whereas Eview-9 automatically selected the best models by evaluating different model options. Table 4 reports the log model selected for each trading partner, the number of models evaluated, the R^2, DW statistic and the F-statistic. In the case of Angola SIC was used while AIC criteria was used for the remaining nine cases. The criteria selected have the lowest values while the number of models evaluated ranged from 8 models in some cases to the highest with 2058 models evaluated. Although the R^2 values are low, i.e. between 0.336326 and 0.652333, the F-statistics is significant in all cases while the DW ranges between 1.863828 and 2.084436 which indicates that the models do not suffer from autocorrelation problems.

Table 4: Automatic maximum lag selected models by using Eview 9

Trading partner	**Selected Model**	**Number of models evaluated**	**Model selected method**	**R squared**	**DW**	**F-statistic**
Angola	ARDL (1,0,1,0)	54	SIC	0.453683	2.084436	6.458974 (0.000)
Botswana	ARDL (1,0,0,0)	54	AIC	0.336326	1.978619	4.624219 (0.000)
China	ARDL (5,4,0,6)	2058	AIC	0.652333	1.951853	4.605499 (0.000)
Switzerland	ARDL (1,0,0,0)	8	AIC	0.300431	2.000807	3.918738 (0.001)
Spain	ARDL (1,2,0,0)	192	AIC	0.558717	2.36384	8.609606 (0.000)
Germany	ARDL (3,0,0,0)	192	AIC	0.501602	1.920337	6.843702 (0.000)
Italy	ARDL (1,2,0,1)	1080	AIC	0.409129	2.068897	4.154506 (0.000)
South Africa	ARDL (1,0,0,0)	8	AIC	0.432775	1.863828	6.962088 (0.000)
UK	ARDL (1,0,0,0)	8	AIC	0.354418	1.981763	5.009536 (0.000)

USA	ARDL (3,1,3,1)	192	AIC	0.636226	1.981833	7.462236 (0.000)

Source: Authors' compilation and estimated values obtained from Eviews

4.4 ARDL Bound Test to Co-integration

Upon establishing the order of integration presented in Table 3 and selecting the optimal lag model shown in Table 4 to be used in ARDL modeling, the next step involved employing an ARDL bound test approach to co-integration in order to determine whether or not there is a long run relationship amongst the variables in the model. Under the bounds test one can either use the F-test or the Wald test. This study employed the Wald test which uses the Chi-square statistics to determine the existence of such a relationship for all cases. The results of the Chi-square and the corresponding P-values are presented in Table 5. These results suggest that there is a long run relationship among the variables in the model for all cases, hence, the null hypothesis of no co-integration is rejected at 10% level of significance or less. However, Bahmani-Oskooee et al (2008) maintained that results such as those reported in Table 5 are only preliminary, therefore a more efficient way of establishing co-integration is through the estimation of an error correction model and evaluate its error correction term (ECT). It is important to note that all inferences made from long run estimates gain validity only if co-integration relationship is established among the variables in the model Vural (2015). Thus, the importance of this step of the procedure.

Table 5 : Co-integration test results

Trading partner	**Chi-square**	**P-value**	**Cointegration**
Angola	20.755	0.000	Cointegration
Botswana	18.882	0.001	Cointegration
China	17.504	0.002	Cointegration
Germany	7.797	0.099	Cointegration
Italy	34.303	0.001	Cointegration
South Africa	15.374	0.004	Cointegration
Spain	52.947	0.000	Cointegration

Switzerland	20.005	0.001	Cointegration
UK	9.871	0.043	Cointegration
US	16.915	0.002	Cointegration

Source: Authors' compilation and estimated values obtained from Eviews

Notes: Rejection of null hypothesis of no cointegration at 10% and less.

4.5 Long-run analysis

The existence of co-integration among the variables in the model is a necessary requirement for the estimation of a long run model. Hence upon establishing co-integration the long run model in equation (3.5) was estimated using ARDL and results reported in Table 6.

As expected from the literature, currency devaluation makes exports competitive and discourages imports, paving the way for an improvement in the trade balance. An increase in real domestic income will stimulate imports and the coefficient of the domestic income is expected to be negative (Bahmani-Oskooee & Harvey, 2009). If, however, the increase in the domestic income is due to an increase in the production of import-substitute goods, the impact on the trade balance of domestic income will be positive. While a rise in the trading partner's real income will increase the exports and therefore the trade balance will improve. Like in the case of domestic income, if the rise in the partner's income is resulting from the increase in the production of import-substitutes, the effect on the trade balance will be negative (Baba &Yazici, 2016).

Analysis of the long run estimates in Table 6 shows that in the cases of Angola, Botswana, UK and the USA the real exchange rate coefficient contradicts existing economic theory as it carries a negative sign and is highly significant. The negative sign and highly significant coefficient in these cases depicts a negative long run relationship between real exchange rate and bilateral trade balance for Namibia against this group of countries. It implies that a depreciation (appreciation) of the domestic currency would cause bilateral trade balance between Namibia and this group of

countries (Angola, Botswana, UK and US) to deteriorate (improve). Analysis of the magnitude of the coefficients for this group of countries show that a 10 percent rise (depreciation) in the RER of the domestic currency leads to a deterioration of 3.3 percent, 7.8 percent, 9.3 percent and 28.3 percent in the bilateral trade balance between Namibia and (Angola, Botswana, UK and the US) respectively. This implies that as real depreciation or devaluation takes place causing real exchange rate to increase, rather than exports to improve as theoretically expected, it deteriorates while imports rather increase and as a consequence, the balance of trade situation worsens. This shows that Namibia is a net importer as it heavily depends on imports from the rest of the world, hence, depreciation will not discourage Namibians from importing from these countries. It is revealed further that at least in the long run, real exchange rate is a significant determinant of the corresponding trade balances.

These results are not consistent with the Marshall-Lerner condition which implies that currency depreciation/devaluation raises the level of competitiveness which in turn encourages exports while discouraging imports. Chiloane (2013) stressed that the net effect of currency depreciation resulting in higher exports and lower imports, is an improvement in the trade balance. Hence, the study failed to find any evidence in support of the Marshall-Lerner condition in all cases, meaning that depreciation in the domestic currency is not effective in improving bilateral trade balance between Namibia and (Angola, Botswana, UK and the USA).

Similarly, the results in the four cases (China, Germany, South Africa, and Switzerland) out of the remaining six carry a negative unexpected sign, but statistically insignificant, implying that currency depreciation is not a significant factor in influencing bilateral trade balance between Namibia and these four countries. Whereas in the remaining two cases (Italy and Spain), the sign

of the coefficient is positive as expected, but statistically insignificant, which entails that variations in RER have no meaningful effect on Namibia's bilateral trade balance with Italy and Spain.

Table 6. Results of the long run impact of RER on Namibia's bilateral trade balance

Trading partners	**Constant**	$\boldsymbol{lnY_t^d}$	$\boldsymbol{lnY_t^f}$	$\boldsymbol{lnRER_t}$
Angola	28.703*** (7.726)	0.661 (1.145)	-3.234*** (-5.413)	-0.333*** (-4.162)
Botswana	12.021*** (4.060)	-2.368*** (-3.896)	0.930*** (3.517)	-0.780*** (-3.540)
China	-1.740 (-0.596)	1.638** (2.011)	-0.759** (-2.061)	-0.426 (-1.065)
Germany	-1.952 (-0.074)	-0.115 (-0.284)	0.128 (0.067)	-0.091 (-0.404)
Italy	-336.20*** (-5.866)	-0.500 (-1.422)	23.603*** (5.964)	0.536 (1.655)
South Africa	34.275*** (6.188)	1.132*** (5.422)	-3.311*** (-6.391)	-0.103 (-1.030)
Spain	53.020 (1.663)	0.162 (0.335)	-3.643 (-1.472)	0.216 (0.367)
Switzerland	-312.556*** (-4.984)	-5.708*** (-3.566)	27.464*** (4.903)	-0.133 (-0.179)
UK	21.676 (0.620)	-1.929*** (-3.264)	-0.232 (-0.088)	-0.929*** (-3.109)
USA	-12.61 (35.902)	1.099** (2.151)	0.756 (0.315)	-2.826*** (-5.066)

Source: Authors' compilation and estimated values obtained from Eviews

*Notes: The absolute t-values in parenthesis, *** and ** imply statistical significance at 1% and 5% respectively.*

In the long run Namibia's (domestic) real income was found to be one of the major factors influencing Namibia's bilateral trade balance in six out of the ten countries i.e. with Botswana, China, South Africa Switzerland, UK and the US.

In the case of Botswana, Switzerland and the UK, the coefficient of real domestic income is as expected, negative and significant. This implies that in the long run, there is a negative relationship between domestic income and bilateral trade balance between Namibia and this group of countries, implying that an increase in real domestic income boosts domestic propensity to import which in turn worsens Namibia's bilateral trade balance with Botswana, Switzerland and the UK, as the

value of domestic import increases more than the export value. Put differently, it means the production and export capacity of Botswana, Switzerland and the UK is rising at higher rates compared to that of Namibia which translates to more exports to Namibia or fewer imports from Namibia, worsening Namibia's bilateral trade balance.

In the case of China, South Africa and the US, the coefficients of real domestic income was found to be positive and significant (see Table 6), implying a positive relationship between real domestic income and bilateral trade balance. This suggests that a rise in Namibia's real domestic income improves bilateral trade balance between Namibia and this group of countries. The improvement in the bilateral trade balance follows advanced domestic production of import-substitute goods, which Namibia imports less as income rises and export more, thereby improving the trade balance, as asserted by Baba and Yazici (2016).

In the remaining four cases (i.e. Angola, Germany. Italy and Spain), the coefficients of real domestic income appear to be statistically insignificant. Therefore, it implies that changes in real domestic income have no influence on the bilateral trade balance between Namibia and these countries.

The impact of real foreign income on Namibia's bilateral trade can be deduced from the coefficient of real foreign income presented in Table 6. An examination of these coefficient suggest that real foreign income is a major factors in influencing Namibia's bilateral trade especially with six out of ten countries, while remaining insignificant in the other four cases.

In the cases of Botswana, Italy and Switzerland, real foreign income met theoretical expectations, i.e. positive and highly significant. This implies that an increase in real income for Botswana, Italy and Switzerland improves Namibia's bilateral trade balance with these countries. This is because these countries are expected to increase their volume of imports from Namibia which in turn

increases Namibia's exports to these countries and hence improve Namibia's bilateral trade with them in the long run. Trading partners of Namibia with relatively higher real income import more from Namibia thereby improve the trade balance of Namibia; this is implied by the absorption theory discussed earlier the literature. According to Baba and Yazici (2016) the income-effect is relevant in this case. On the other hand, the coefficient of real foreign income for Angola, China and South Africa is negative and significant at 5% level of significance or less, which means that the increase in real income of these countries worsens Namibia's bilateral trade balance with them in the long run. According to Baba and Yazici (2016), this relationship can be attributed to a theory explaining that an increase in real foreign income emanates from improved domestic production of highly imported products from the domestic country by foreigners. Hence, applying this explanation to this case implies that an increase in the real incomes of Angola, China and South Africa is due to advancement in the domestic production of products that these countries import from Namibia, thus reducing the volume of their imports from Namibia. This further implies that if foreign demand for domestic export declines then Namibia's bilateral trade with those countries worsen. In other words, this results in more exports to Namibia or less imports from Namibia, and thus, adversely affecting Namibia's bilateral trade with these countries in question. Baba and Yazici (2016) submits that the substitution effect is more considerable in such cases.

4.6 Short run analysis

In order to estimate the error correction model, equation (3.6) was estimated using ARDL, but due to the large volume of data, Table 7 presents only the short run coefficient estimates of the lagged first differenced real exchange rate and the results of the corresponding error correction term (ECT) for each respective model.

According to Vural (2015) and Ţuţueanu (2015), the coefficient and significance of the real exchange rate is key in determining the J-Curve effect (short run). Further, Vural (2015) and Bahmani-Oskooee et al., (2008) submit that a positive sign on the real exchange rate coefficient implies that appreciation of domestic currency improves the trade balance whereas depreciation worsens the trade balance. Additionally, a positive sign implies that a depreciation of the local currency is associated with a negative trade balance. On the other hand a negative sign on the real exchange rate coefficient shows that weakening local currency positively impact the trade balance, whereas the appreciation of local currency negatively impact the trade balance in the short run.

The present study follows Magee (1973) definition as adopted by Baba and Yazici (2016); Ţuţueanu (2015); Vural (2015); Bahmani-Oskooee et al (2008) to investigate the J-Curve effect. That is, an initially (at least one lagged) negative coefficient that is significant at least at 10% level followed by a significant positive one(s) on the lag coefficients would be consistent with the J-Curve effect. Subsequently, equation (3.6) was estimated and the results reported in Table 7. It can clearly be observed in the results shown in panel A of Table 7 that the lagged differenced coefficient of real exchange rate is negative as expected by theory but for only five out of the ten cases i.e. in the bilateral trade between Namibia and Angola, Botswana, China, Italy and the US, however, the coefficients are statistically insignificant, signifying that real devaluation of the Namibia dollar against the currencies of this group of countries have no short-run impact on the

bilateral trade balance between Namibia and this group of countries. Since the J-Curve is a short run phenomenon as alluded by Abd-El-Kader (2013), the study concludes from these results that there is no evidence in support of the J-Curve effect for Namibia's bilateral trade with this group of countries. The lack of evidence to support the existence of the J-Curve effect have also been found by various authors including Bahmani-Oskooee *et al* (2005), Halicioglu (2008), Yuel-Ling *et al* (2008), Tarasova (2009), Moodley (2010), Ogundipe *et al* (2013), Ţuţueanu (2015), Ziramba and Chifamba (2014), Aliyu and Tijjani (2015), Hoang (2016), Oluyemi and Essi (2017), Thom (2017) and Gan-Ochir (2018).

In the case of China, the real exchange rate coefficient is positive and is significant at 5% in the fourth quarter lag, indicating that real exchange rate is a major factor in influencing Namibia's bilateral trade balance with China. This means that a devaluation of the Namibian dollar improves Namibia's bilateral trade balance with China in the short run, contradicting theoretical expectations. These results collaborate with Baba and Yazici (2016) conclusion on bilateral trade balance between Nigeria and France.

Table 7. Short-run Coefficient Estimates of ΔlnRER

Partners	**Panel A**				**Panel B**
	$\Delta lnRER_t$	$\Delta lnRER_{t-1}$	$\Delta lnRER_{t-2}$	$\Delta lnRER_{t-3}$	ΩEC_{t-1}
Angola	-0.449				-0.634*
Botswana	-0.450				-0.462*
China	-1.099	-0.031	1.083	1.555*	-0.616*
Germany	0.229				-0.422*
Italy	-0.803				-0.760*
South Africa	0.228				-0.462*
Spain	0.012				-1.194
Switzerland	0.926				-0.483*
UK	0.273				-0.320*
US	-2.552	-2.611			-0.518*

Moreover, in the case of Germany, South Africa-Namibia's largest trading partner, Spain, Switzerland and the UK, the coefficients in these remaining five cases are positive but insignificant which implies that the real devaluation of the Namibian dollar has no effect on the bilateral trade balance between Namibia and this group of countries in the short run, subsequently the null hypothesis of no evidence of the J-Curve effect for Namibia and this group of countries cannot be rejected. Similar conclusions can also be drawn when Vural (2014) strict definition for the J-Curve is adopted, stating that the J-Curve effect is supported in cases were positive estimates of coefficient at lower lags are turned into negative coefficients at higher lags.

Even though the classical J-Curve effect expounded by Magee in 1973, that the trade balance deteriorates and then improves following a real depreciation of domestic currency in the short-run was not detected, for the purpose of robustness, the present study also tested the phenomenon based on Rose and Yallen (1989) definition of the J-Curve effect. As alluded by Rose and Yallen (1989), the J-Curve is defined to reflect short-run deterioration and long run improvement. Hence, this requires analysis of the long-run impact of currency devaluation and combines it with the short-run impact in order to form further opinions. Subsequently, the study found no evidence of the J-Curve effect for all cases.

Despite the sign differences between the coefficients of the real exchange rate for all ten cases which appear to be negative for half of the cases and positive for the other half, they have something in common, that is, all the coefficients are statistically insignificant, implying that the J-Curve effect is not supported in all ten cases.

Furthermore, analysis of the error correction model reveals that there is co-integration relationship in all bilateral trade relationships as shown in panel B of Table 6. As the error correction terms (EC_{t-1}) was found to be as expected, that is, statistically significant (at 5%in

this case) and are all less than unit, hence confirming to earlier findings of a temporal co-integration presented earlier in Table 5. In the case of bilateral trade between Namibia and Spain, the EC_{t-1} carry an expected negative sign but it is insignificant and more than unity, implying that in this particular case the null hypothesis of no co-integration cannot be rejected. Finally, the magnitude of speed of adjustment coefficient for most countries are considerably high, indicating that the steady state equilibrium can be re-established rapidly per quarter in the event Namibia was to face an external shock. On the other hand, according to Mukhtar and Rasheed (2010), the low absolute value of EC_{t-1} is indicative of low speed of adjustment, meaning that speed of adjustment of trade balance towards its long run equilibrium is a slow one.

4.7 Model Diagnostic tests

In order to produce the best linear unbiased estimators, a model must satisfy the classical assumption stated by Gujarati (2004), that it must be normally distributed with a constant and a zero mean. Hence, it was necessary to carry out diagnostic tests to detect any spurious results. To this end, the study performed various efficiency tests for the model. Table 8 reports the P-values of various statistics and as it can be seen in the table, the Jarque-Bera statistic fails to reject the null hypothesis that the residuals in most scenarios follow a normal distribution. Except in the case of Botswana and South Africa in which the probability is less than 5%, hence rejecting the null hypothesis of a normally distributed residual. This implies that for these two cases the residuals do not follow a normal distribution.

The probability of the F-statistic for the Ramset test are higher than 5% for all countries, meaning that the Ramset test fail to reject the null hypothesis that the models are stable, thus confirming stability of the model in these cases. However, the Ramset test rejects the null hypothesis for the

case of Spain only, as the probability of the F-statistic is less than 5%, meaning that in this case the model is unstable according to the Ramset test.

Heteroskedasticity test by means of the Breusch-Pagan-Godfrey test confirms that the variances in eight out of ten cases are constant as the probability in these eight cases are more than 5%, hence the null hypothesis of constant variance or homoscedasticity cannot be rejected. In the two remaining cases (China and Switzerland), the null hypothesis of constant variance is rejected implying that the variance in these two out of ten cases are not constant, which implies that they are heteroskedastic. The presence of heteroskedasticity shows that the estimates are still unbiased but not efficient (Fillemon, 2017).

Similarly, the ARCH test results fail to reject the presence of heteroskedasticity among the residuals in the model of Switzerland only, but reject the null hypothesis of nine cases out of ten, indicating that these models are homoscedastic.

The probability of the Breusch-Godfrey LM test indicates that there is no correlation in the error terms in the model of all ten countries, this is because the probability of the observed R-squared in all ten cases are more that 5%, hence the null hypothesis of no autocorrelation cannot be rejected.

Table 8: Results of diagnostic tests

Trading Partner	**Jarque-Bera**	**Ramsey Reset**	**Breusch-Pagan-Godfrey**	**Breusch-Godfrey LM test**	**ARCH test**	**DW Stats**
Angola	0.897	0.665	0.826	0.298	0.216	2.064
Botswana	0.023	0.401	0.324	0.821	0.720	1.948
China	0.476	0.969	0.025	0.484	0.545	1.809
Germany	0.977	0.118	0.201	0.693	0.870	1.919
Italy	0.544	0.887	0.179	0.590	0.315	2.014
South Africa	0.000	0.108	0.295	0.505	0.887	1.860

Spain	0.113	0.029	0.133	0.399	0.692	2.014
Switzerland	0.343	0.613	0.011	0.888	0.010	1.984
UK	0.126	0.666	0.567	0.995	0.590	1.993
USA	0.061	0.822	0.399	0.921	0.805	1.901

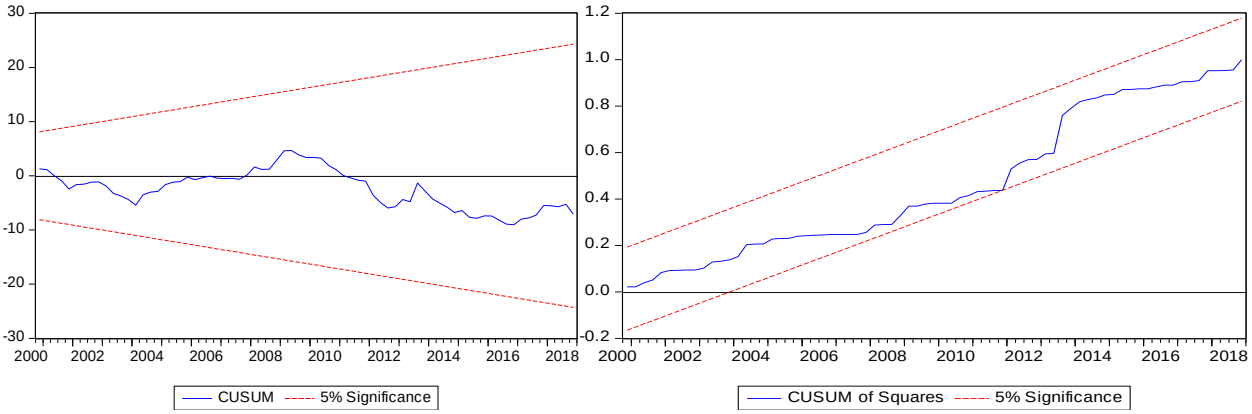
Notes: Values shown in the table represent P-values except for the DW statistics.

The DW statistic also confirms the results of the Breusch-Godfrey LM test that there is no autocorrelation in all equations, as the DW statistic reported in Table 8 for all countries are all close to 2 which is recommended by literature.

Finally, even though co-integration has been established amongst the variables in the model, Bahmani-Oskooee et al (2008) maintains that co-integration does not imply stability. Hence, formal stability tests must be performed within the co-integration framework. According to Yin and Hamori (2011) model stability is necessary for prediction and inferences. Thus, the study follows Baba and Yazici (2016) to test for the stability of the long run coefficients after incorporating the short run dynamics into the testing procedure. The test involves applying the CUSUM test and CUSUMSQ of Brown et al (1975) to the residuals of equation (3.3). Again, due to large volume of data, only the results for the case of bilateral trade between Namibia and South Africa are presented in Figure 1. The rest of the results for the other countries are summarized in Table 8.

As can be seen in Figure 2, the plots of both statistics are within the straight lines or the critical boundaries at 5% level of significance, indicating no evidence of instability in the model. Moreover, this implies that the long run and the short run coefficients estimates of the bilateral trade balance model between Namibia and South Africa are stable and properly specified.

Figure 2: Plots of CUSUM and CUSUMSQ of Squares: Namibia-South Africa



Furthermore, a summary of results for the other models as presented in Table 8 suggest no evidence of instability in most cases except in the case of the US, the CUSUMSQ provide evidence of mild instability.

Table 8: Stability test results based on CUSUM test and CUSUMSQ

Trading Partner	CUSUM test	CUSUMSQ
Angola	Stable	Stable
Botswana	Stable	Stable
China	Stable	Stable
Germany	Stable	Stable
Italy	Stable	Stable
South Africa	Stable	Stable
Spain	Stable	Stable
Switzerland	Stable	Stable
UK	Stable	Stable
USA	Stable	**Unstable**

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study employed the bound testing approach to co-integration, developed within an ARDL framework to investigate the impact of real exchange rate devaluation on Namibia's bilateral trade balance with its main trading partners. This is because ARDL remains the most suitable approach in achieving the objectives outlined in this study as it allows for a combination of both short run and long run analysis simultaneously. Subsequently, quarterly data spanning from 1998:Q1 to 2018:Q4 was used in the analysis.

Before any estimation could be done, the study employed ADF, PP and KPSS tests to test variables for unit root and to determine the order of integration. Although not a requirement for ARDL, unit root test is important to determine the order of integration (preliminary) as ARDL requires variables that are I(0) or I(1), whereas ARDL will crash under variables integrated at I(2) or higher. The results of the unit root test showed that some variables were I(0) while others were I(1) and none was I(2) or higher. To investigate the long run relationship between the dependent and independent variables, the study employed OLS to estimate coefficients while the short run effect and associated J-Curve effect were explored by estimating an error correction model. The bound test to cointegration was employed to investigate the long run relationship among the variables and the Chi-square statistic used to deduce cointegration. The results of the Chi-square indicated that all variables were cointegrated for all countries, this allowed the estimation procedure to proceed with the short run error correction model. The coefficients of the error correction term from the error correction model for all cases were found to be negative and significant as expected

and were all less than unit except in the case of Switzerland in which the coefficient was found to be more than unity and insignificant.

The empirical findings attained by the present study showed that in the short run, the coefficients of the lagged differenced RER for all models are statistically insignificant. This implies that depreciation does not lead to sudden deteriorations followed by improvements in the export to import ratio of Namibia and each of its major trading partner in the short run. These results are not consistent with the J-Curve phenomenon, stating that an initial negative sign must be followed by a positive sign on the lagged coefficient. Hence, this study failed to find any evidence in support of the J-Curve effect for all the countries considered in the analysis.

In the case of China however, it was established that at least in the 4^{th} quarter lag, real exchange rate plays a major role in influencing bilateral trade balance between Namibia and China in the short run, that means a devaluation of the Namibian dollar improves Namibia's bilateral trade balance with China in the short run. This finding is contradictory to common economic knowledge.

Analysis of the long run model showed that a depreciation of the Namibian dollar was found to have a negative impact on Namibia's bilateral trade balance in the long run. In particular, depreciation of the Namibia dollar worsens bilateral trade deficits between Namibia and these countries (Angola, Botswana, UK and the USA) in the long run. These results are not consistent with the Marshall-Lerner condition, hence this study failed to find any evidence in support of the M-L condition in the case of Namibia's bilateral trade with Angola, Botswana, UK and the US.

Similarly, the study further found a negative relationship in the case of Namibia vs. China, Namibia vs. Germany Namibia vs. South Africa and Namibia vs. Switzerland, as the coefficient of the RER in these respective cases were found to be negative. However, these coefficients turned out to be

insignificant, meaning that changes in RER of the local currency has no influence over bilateral trade balance between Namibia and this group of countries. Similarly, the study revealed that RER is not a significant factor to influence bilateral trade balance between Namibia and Italy and Namibia and Spain as the RER coefficients in these two cases were positive and insignificant.

Analysis of the long run impact of real domestic income on bilateral trade balance showed a negative relationship between real domestic income and bilateral trade balance between Namibia and (Botswana, Switzerland and the UK). This suggests that a rise in Namibia's (domestic) real income worsens bilateral trade balance between Namibia and these countries. This follows an increase in the propensity to import as real domestic income rises and hence deteriorates bilateral trade balance.

On the other hand, a positive long run relationship was found between real domestic income and bilateral trade balance between Namibia and China, South Africa and the USA. These results mean that a rise in Namibia's real domestic income improves bilateral trade balances between Namibia and these group of countries. This improvement in the bilateral trade balance can be attributed to improved domestic production of import substitute goods which means less volume of imports and high volume of exports, hence improving the bilateral trade balance.

In contrast, a long run negative relationship was also found between real foreign income and bilateral trade balance between Namibia and Angola, China and South Africa, implying that if real income of any of these countries rise due to advanced domestic production of imported goods in these countries, then Namibia's foreign demand for exports deteriorates which in turn worsens the bilateral trade balance between Namibia and these countries.

In the cases of Botswana, Italy and Switzerland, the study found that an increase in real income for Botswana, Italy and Switzerland improves Namibia's bilateral trade balance with these countries, as these countries are expected to import more from Namibia which in turn increases Namibia's exports to these countries and hence improve Namibia's bilateral trade with them in the long run

The main findings of this study is that the J-Curve effect was not observable for Namibia and any of its major trading partners. This is because the lagged coefficients of the RER were found to be insignificant except for China that showed a positive and significant coefficient of RER in the fourth quarter lag, this does not conform to the pattern of the J-Curve effect. Similarly, the study found that the M-L condition did not hold for the case of Namibia as the lagged coefficient of the RER were found to be insignificant. However, in the case of Angola, Botswana, UK and the USA, the RER coefficients were found to be negative and significant, implying that devaluation negatively impact bilateral trade balance between Namibia and this group of countries.

It was also revealed in the study that real domestic and foreign income impacts Namibia's trade bilateral balance. In some instances the impact is negative and positive for some, for both real domestic and real foreign income.

In order to validate the coefficient estimates of the findings in this study, all models were subjected to diagnostic tests such as the Jarque-Bera test, Ramset test, Breusch-Pagan-Godfrey test, Breusch-Godfrey LM test, ARCH test and finally the CUSUM test and CUSUMSQ. Eight models out of ten passed the diagnostic tests and in the case of the COSUMSQ only the model of bilateral trade between Namibia and the US appeared to be mildly unstable.

5.2 Recommendations and further studies

The results derived from this study have important policy implications for the bilateral trade balance in Namibia. The lack of evidence in support of the J-Curve effect and the non-existence of the M-L condition imply that policy makers in Namibian cannot depend on real exchange rate devaluation to improve Namibia's bilateral trade balance with its main trading partners. This is true considering the fact that Namibia is a member of the CMA and hence, it is not fully independent in executing domestic monetary policy. Therefore, the Government should consider a trade policy that could boost the export industry e.g. more investment in value addition of primary goods, mostly minerals, fish and beef that seem to dominate the list of exports in their raw form. This implies investment in manufacturing plants that could ensure transformation of primary goods into semi-finished or finished goods for exports.

Fixed but stable exchange rates are vital to national and global economic stability but for Namibia this has not been the case due to recent volatility of the rand to major currencies. Part of the economic crisis Namibia is currently facing, among many factors, is the pegging of the Namibian dollar to the South African rand which has performed poorly causing the Namibian dollar to follow suit. This has sparked a lot of debate from many economists whether Namibia must abandon the fixed peg for alternative systems such as the flexible exchange rate system which could liberate Namibia to execute independent monetary policy that suits its domestic needs. Although some economists advocate for de-pegging, others are against it citing financial mayhem irrespective of the size of the economy or whether it is an import or export based economy.

Further, the study established that in some cases, both real domestic income and real foreign income were found to be important factors in determining Namibia's bilateral trade balance. Hence, in order to improve Namibia's bilateral trade balance with these countries (e.g. Botswana,

China, South Africa, Switzerland, UK and the USA), Namibia should consider investing in advanced domestic production of import substitute goods as one of the factors.

Finally, policy should not focus on the exchange rate, but rather on the fundamental determinants of the profitability and competitiveness of domestic exporters and import competing industries such as productivity enhancement, infrastructure, constraints to business operations and production costs, including labour costs.

More studies can still be done on Namibia using more disaggregated trade data especially on a commodity level to determine which commodities responds to currency devaluation. Finally, a panel analysis is recommended for future studies as it gives better results that are much easier to interpret.

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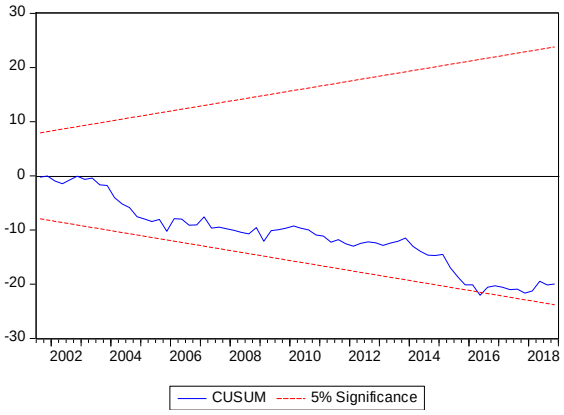
Appendix

Appendix Table 1. Unit root test by KPSS

Variable	KPSS		Order of integration
	Level	1st difference	
lnY			
Angola	1.075 (0.739)	0.112*** (0.739)	I(1)
Botswana	1.118 (0.739)	0.500***(0.739)	I(1)
China	1.142 (0.739)	0.162***(0.739)	I(1)
Germany	1.124 (0.347)	0.042***(0.739)	I(1)
Italy	0.245***(0.739)	0.219***(0.739)	I(0)
South Africa	1.120 (0.347)	0.480***(0.739)	I(1)
Spain	0.877 (0.347)	0.385***(0.739)	I(1)
Switzerland	1.148 (0.739)	0.055***(0.739)	I(1)
UK	1.079 (0.347)	0.237***(0.739)	I(1)
US	1.126 (0.347)	0.209***(0.739)	I(1)
Namibia	1.014 (0.347)	0.127***(0.739)	I(1)
lnTB			
Angola	0.326***(0.347)	0.209***(0.739)	I(0)
Botswana	0.194***(0.739)	0.070***(0.739)	I(0)
China	0.224***(0.379)	0.500***(0.739)	I(0)
Germany	0.129***(0.739)	0.137***(0.739)	I(0)
Italy	0.355***(0.739)	0.500***(0.739)	I(0)
South Africa	0.294***(0.739)	0.211***(0.739)	I(0)
Spain	1.113 (0.739)	1.113***(0.739)	I(1)
Switzerland	0.418**(0.463)	0.081***(0.739)	I(0)
UK	1.012 (0.739)	0.210*(0.739)	I(1)
US	0.294***(0.739)	0.169***(0.7390	I(0)
lnRER			
NAD/Kwa	0.792 (0.347)	0.240***(0.739)	I(1)
NAD/Pula	0.747 (0.739)	0.166 (0.739)***	I(1)
NAD/Yuan	0.830 (0.347)	0.143 (0.739)***	I(1)
NAD/Eur	0.571** (0.739)	0.132*** (0.739)	I(0)
South Africa	0.666*** (0.739)	0.147*** (0.739)	I(1)
NAD/GBP	0.291*** (0.739)	0.119*** (0.739)	I(0)
NAD/USD			I(1)

Appendix figure 1. Plots of CUSUM and CUSUM of Squares: Angola



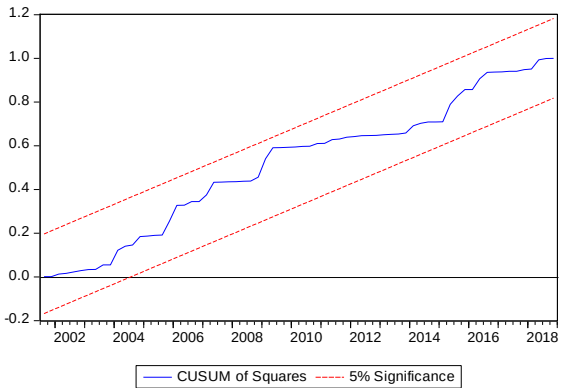
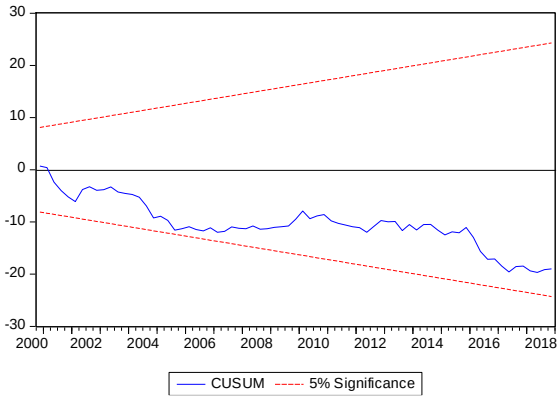


Figure 5. Plots of CUSUM and CUSUM of Squares: Botswana



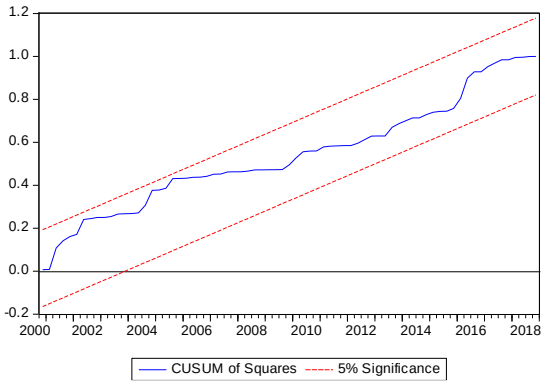
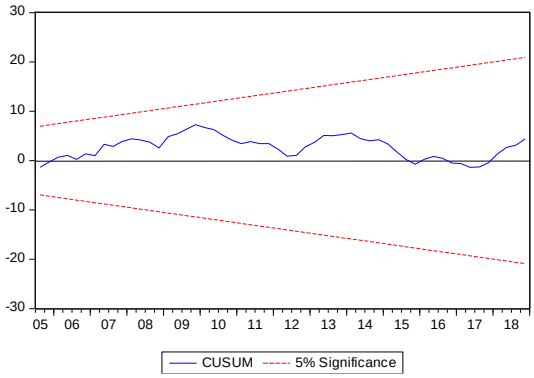


Figure 6. Plots of CUSUM and CUSUM of Squares: China



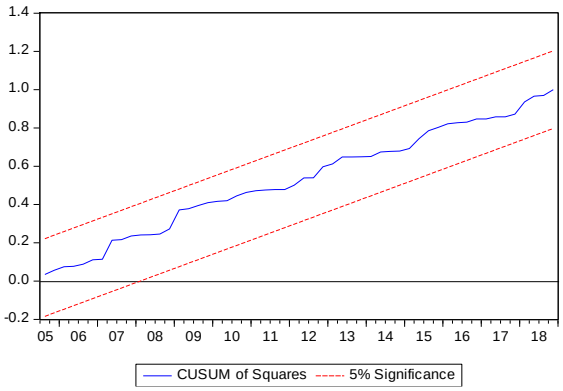
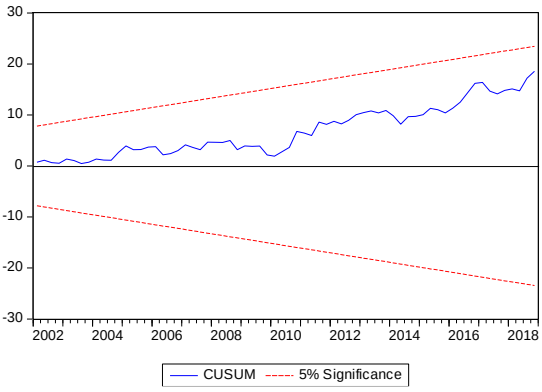


Figure 7. Plots of CUSUM and CUSUM of Squares: Germany



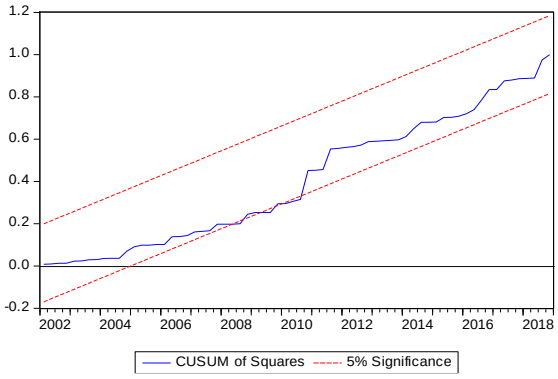
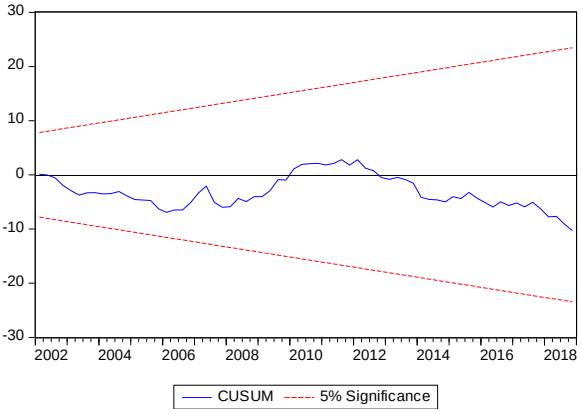


Figure 8. Plots of CUSUM and CUSUM of Squares: Spain



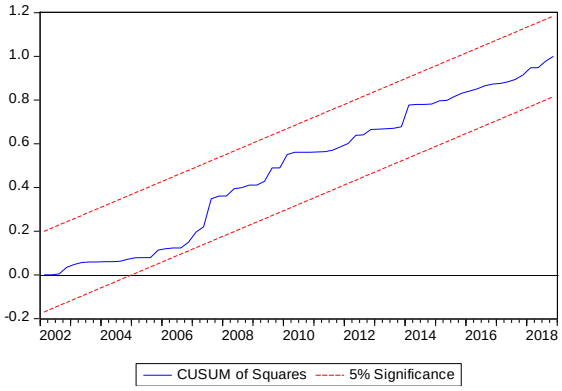
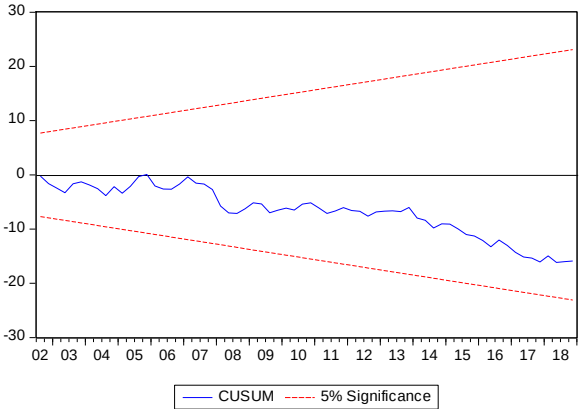


Figure 9. Plots of CUSUM and CUSUM of Squares: Italy



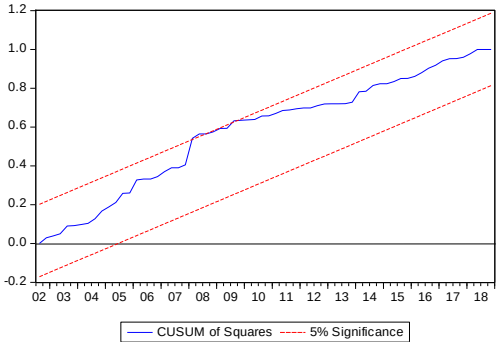


Figure 10. Plots of CUSUM and CUSUM of Squares: South Africa

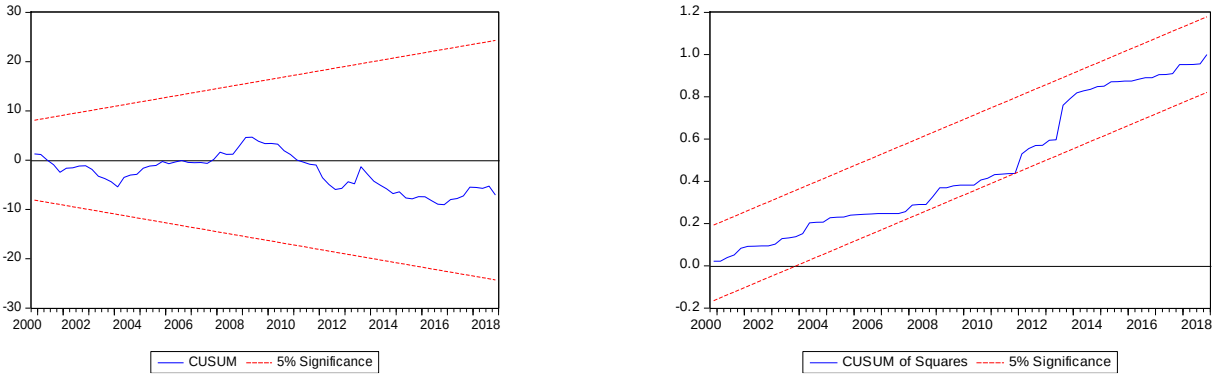


Figure 11. Plots of CUSUM and CUSUM of Squares: Switzerland

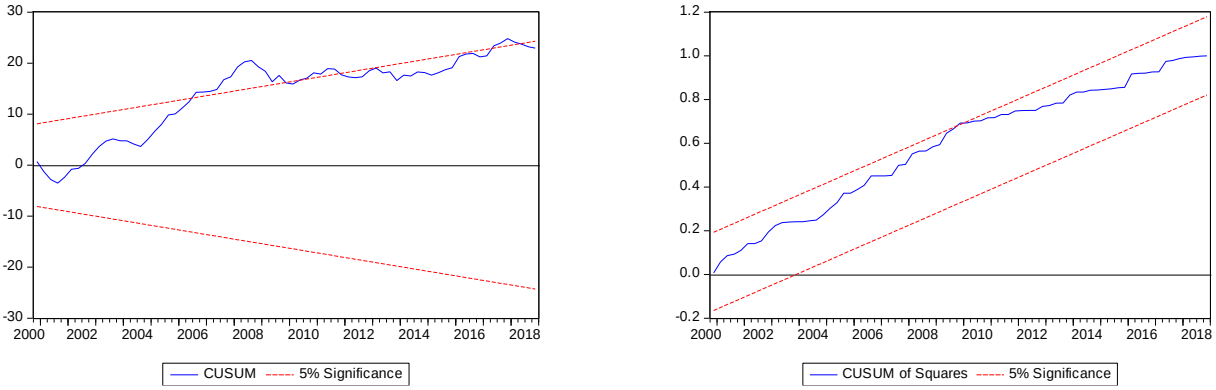


Figure 12. Plots of CUSUM and CUSUM of Squares: UK

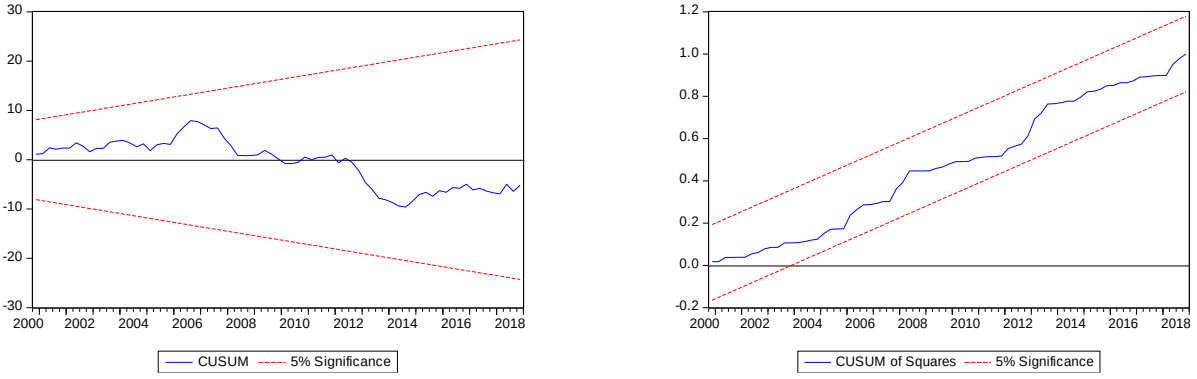


Figure 13. Plots of CUSUM and CUSUM of Squares: USA