

Exchange rate determination in selected African economies

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DECLARATION

I, Zitsile Zamantungwa Khumalo, solemnly declare that this dissertation entitled **“Exchange rate determination in selected African economies”** submitted at the North-West University, Mafikeng Campus, for the degree of Doctor of Philosophy in Economics is my original work and has never been submitted for a degree at this university or any other institution. This is my own work and all the sources used in this study have been properly acknowledged.

Student’s signature:

.....

Date...../...../.....

DEDICATION

I dedicate this to my family. Thank you for your tremendous love and support.

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I thank the Lord for granting me the grace to complete this dissertation.

I am grateful for the financial support received from the North-West University. Without their support, this dissertation would not have been possible.

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ABSTRACT

Exchange rates remain among the most important prices in Africa and the global economy. This is due to the influences the exchange rate has on the flow of goods, services and capital in a country. Moreover, it affects other macroeconomic variables. Hence, the selection and administration of an appropriate exchange rate regime is a vital component of economic management particularly for African countries most of which are small open economies. This study therefore, aimed to examine the issues of exchange rates in African economies. The study explored five aspects of real exchange rates: Real Exchange Rates and Macroeconomic Fundamentals, the Balassa-Samuelson effect, Real Exchange Rate Overshooting, Real Exchange Rates and Commodity Prices and Real Exchange Rate Misalignment, all in the context of African countries. The study was conducted in a selection of African countries using a panel data approach. The selection of countries studied was based on the availability of data and periods covered range from 1980 to 2016. Different econometric models and analytical tools such as the Dynamic Ordinary Least Squares (DOLS) and the Random Effects Model were applied. The results of the study revealed significant relationships between the real exchange rate and some macroeconomic fundamentals. Furthermore, negative and positive coefficients for real exchange rate misalignment for the different models and samples were found, showing periods of undervaluation and overvaluation of the real exchange rate.

Keywords: Real Exchange Rates, Macroeconomic Fundamentals, the Balassa-Samuelson effect, Real Exchange Rate Overshooting, Commodity Prices, Real Exchange Rate Misalignment, Panel Data Approach

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LIST OF ACRONYMS

RER: Real Exchange Rate

ERER: Equilibrium Real Exchange Rate

PPP: Purchasing Power Parity

HP: Hodrick-Prescott

BS: Balassa-Samuelson

ARDL: Autoregressive Distributed Lag

VAR: Vector auto regression (VAR)

GDP: Gross Domestic Product

MISA: Misalignment

FEER: Fundamental Equilibrium Exchange Rate

CPI: Consumer Price Index

REER: Real Effective Exchange Rate

NEER: Nominal effective exchange rate

FDI: Foreign Direct Investment

PMG: Pooled mean group estimator

DOLS: Dynamic Ordinary Least Squares estimator

LLC Test: Levin, Lin and Chu Test

IPS Test: Im, Pearson and Shin Test

ADF: Augmented Dickey-Fuller

ULC: Unit Labour Costs

TFP: Total Factor Productivity

ECM: Error Correction Model

FMOLS: Fully Modified OLS Model

Chapter One

Introduction

1.1. Introductory Statement

The exchange rate is an important subject matter in economics and policymaking issues. This is due to the influences of the exchange rate on the flow of goods, services and capital in a country. It further influences the balance of payments, inflation and other macroeconomic variables. Hence, the selection and administration of an appropriate exchange rate regime is a crucial part of economic management and the protection of competitiveness, macroeconomic stability and growth (Yagci, 2001).

It is for this reason that exchange rate policies have been the topic of conversation at policy discussions throughout the years. This is on the grounds that thorough, relatively stable and appropriate exchange rate policies are vital for the sustainable performance of economies (Iyke and Odhiambo, 2015). This has proven true for several African countries, most of which are classified as small open economies where the choice of an appropriate exchange rate regime is still a critical policy issue (Simwaka, 2010). The exchange rate forms part of imperative determinants of a nation's relative level of economic wellbeing amongst other factors such as, interest rates and inflation. Thus, exchange rates are one of the most immensely scrutinised, analysed and governmentally controlled economic variables.

Exchange rate policy reforms¹ in the 20th Century ushered in a wave of change in the financial landscape of sub-Saharan African countries. The reforms undertaken in 18 countries aimed to move countries towards more flexible exchange rate regimes (Goldin and Winters, 1992). During the 1980s and 1990s, these African countries were compelled

¹ The exchange rate reforms came about after the collapse of the Bretton-Woods fixed exchange rate system. The Bretton Woods system ran from 1945 – 1971 and it was characterised by three things: a gold exchange standard, a fixed (but adjustable peg) exchange rate regime and current account currency convertibility alongside capital controls (Hudson, 2014).

to undertake extensive exchange rate policy reforms; these policy reforms involved an improvement in development strategies. This was a move to liberalise their economies, particularly, their international trade and foreign exchange rate regimes (Maehle, Teferra and Khachatryan, 2013). The liberalisation² of these economies was envisaged that it would create a unified market determined exchange rate regime and reduce the spread between parallel market³ rates and official exchange rates (Wohlmuth, Gutowski and Kandil, Knedlik and Uzor 2014). The reforms were:

- Improvement of foreign exchange market transparency and eliminating all restrictions on the foreign exchange market;
- Removal of surrender requirements to the Bank of Sudan on foreign exchange receipts from exports;
- Development of indirect monetary instruments for managing excess liquidity and for intervening in the unified foreign exchange rate market;
- Uniting the various exchange rates;
- Ensuring tightened monetary and fiscal policies.

The macroeconomic basis on which these reforms were undertaken were characterised by hurried demand growth during the 1970s because of the boom in many primary commodity prices and the failure to adapt to deteriorating terms of trade effectively during the 1980s. Instead of an effort to stabilise the economy, most Sub-Saharan Africa governments responded to the deteriorating economic environment by expanding trade protection and exchange controls to avoid balance of payments crises, while maintaining the unsustainable trend in aggregate demand. The worsening macroeconomic imbalances prompted capital flight, considerable real exchange rate overvaluation and the development of parallel markets for foreign exchange (Sekkat and Varoudakis, 2000).

To date, countries such as Zambia, Kenya, Tanzania, Uganda and Ghana amongst others reformed effectively and made notable changes in their economies. For instance,

²Extensive foreign exchange rationing, sizeable black-market premiums and declining per capita real income dominated a majority of these countries before liberalisation (Maehle *et.al*, 2013).

³ "A parallel market is an unofficial market for shares, currencies and so forth, which works at the same time as the official market," <http://dictionary.cambridge.org/dictionary/english/parallel-market>.

per capita income increased by 2.5 - 5% annually for decades and rationing and parallel markets have been eradicated. However, there are few Sub-Saharan African countries that failed to transition successfully into a market-determined exchange rate. These Sub-Saharan African countries have been experiencing challenges with foreign exchange shortages, rationing, and parallel foreign exchange market spreads (Maehle, Teferra and Khachatryan, 2013).

Theoretical and empirical research completed over the years has increased an understanding of exchange rates. This study further expounds on the issues of exchange rates in African countries. This is an instrumental step towards identifying appropriate and effective exchange rate policies that can set Africa on a path of sustainable economic growth and development. The study consists of four separate but intertwined articles in the field of exchange rates in selected African countries. The real exchange rate is the central theme for this study. The following section describes different types of exchange rates and exchange rates regimes.

1.1.1. Exchange Rate Regime, Real and Nominal Exchange Rates – Brief Overview

The Central Bank of Seychelles defined an exchange rate regime as:

the way the value of the domestic currency in term of foreign currencies is determined. It has close relations with the monetary policy and the two are normally reliant on several similar factors.

The exchange rate is defined as the price of a country's currency stated in another country's currency. Normally, exchange rates are differentiated between fixed or floating exchange rates (Ghosh, Gulde and Wolf, 2002). Under fixed exchange rates, the price of one currency is fixed relative to all other currencies by government authorities; while under floating exchange rates, a currency's value can fluctuate in response to market forces (Megginson and Smart, 2008).

Husain *et.al* (2004) mentioned that fixed exchange rate regimes gave an impression of appropriateness for countries confronted by inadequate financial market development and fairly closed capital markets. When measuring credibility, growth objectives and the

delivery of a consistent monetary policy to avoid great and volatile parallel market premium, are not compromised by fixed exchange rate regimes.

However, there have been concerns about fixed exchange rates. These concerns stem from their lack of ability to mitigate real shocks. A fixed exchange rate regime demands reserves and contingent loans from the government for the sustenance of the system. An inability by a government to sustain the system results in a currency crisis and a subsequent collapse of the exchange rate. Majority of emerging and developing countries are better suited by a flexible exchange rate regime because flexible regimes respond well to external shocks, prevent bank crises and aid in the restoration of stability (Cardoso and Galal, 2006).

Other types of exchange rate regimes include free-float and managed float. In a free-float regime, financial markets create the exchange rate with no direct government intervention. An ideal case of a free-float regime is where the Central Bank does not interfere in currency markets to fix exchange rates and importing inflation or deflation from other countries. Secret government intervention in the markets renders the free-float a “dirty-float” (Leonard, 2013). A “dirty-float” is a managed float which involves government intervention to administer exchange rate movements. This regime lies between the free floating system where exchange rates fluctuate freely without boundaries and the fixed rate system where governments sometimes intervene (Madura, 2009).

1.1.2. Nominal and Real Exchange Rates

The nominal exchange rate is defined as the rate at which a currency of a country is traded with the currency of another. Nominal exchange rates are the exchange rates that are reported daily in mass media (Calmfors *et.al*, 1997). Whilst, real exchange rates are rates at which goods and services of one country can be traded for the goods and services of another (Mankiw, 2008).

The relative price level between two countries is the price in a common currency of a representative basket of goods and services in one of the countries in relation to the same basket in another country. Generally, the relative cost is measured as the labour cost per produced unit in manufacturing in one country in relation to the corresponding cost in

another country expressed in a common currency (the relative unit labour cost). Thus, the real exchange rate is dependent upon the level of prices (wages) and the nominal exchange rate (Calmfors *et.al*, 1997). For this study, exchange rate refers to the real exchange rate.

The real exchange rate (RER) is defined as the relative price of tradables with respect to non-tradable goods:

$$RER = \frac{\text{Price of Tradable Goods}}{\text{Price of Nontradable Goods}} \quad (1)$$

A working definition of the real exchange rate is as follows:

$$RER = \frac{E P_T^*}{P_N} \quad (2)$$

Where E the nominal exchange rate is defined as units of domestic currency per unit of foreign currency, P_T^* is the world price of tradables and p_N is the domestic price of non-tradables.

The real exchange rate has an important feature, that of being a good proxy of a country's degree of international competitiveness. The real exchange rate measures the cost of producing tradable goods domestically. A decrease in the real exchange rate reflects an increase in the domestic cost of producing tradable goods. If no changes occur in relative prices in the rest of the world, the decline in the real exchange rate signifies a weakening of the country's degree of international competitiveness. Generally, the country tends to produce goods in a less efficient way than before (Edwards, 1987).

The equilibrium real exchange rate is a general equilibrium concept and it results in the concurrent achievement of equilibrium in both the external sector and the domestic sector of the economy. The implication is that when the real exchange rate is in equilibrium, the economy is accumulating (decumulating) assets at the anticipated rate and the demand for domestic goods is equal to its supply (Edwards, 1987).

1.2. Overview of the Research Problem

The importance of the real exchange rate as a key role player in African economies has been highlighted above, setting precedence for the rest of the study. The real exchange rate plays a role by providing an environment conducive for sustainable economic performance, indicating the degree of international competitiveness and being a guide for policy makers through its equilibrium position and divergences from the equilibrium.

Studies throughout the years have provided some evidence that exchange rates predict fundamentals, which suggests that (expected) fundamentals are crucial for exchange rates. With respect to Africa, it has been found that African countries utilise currencies that have different exchange rates which do not reflect their economic fundamentals. In reality, most of exchange rates appear to be predetermined according to political instead of economical consideration (Ntamark and Teke, 2016).

A real exchange rate that is in equilibrium is important because the deviation of the real exchange rate from its perceived ideal position presents a detriment to economic performance, currency stability and general macroeconomic equilibrium. A short-run reaction (depreciation or appreciation) to a change in market fundamentals greater than its long-run reaction results in exchange rate overshooting. Thus, changes in market fundamentals put forth an excessively great short-run effect on exchange rates. Additionally, exchange rate overshooting is vital since it clarifies why exchange rates sharply depreciate or appreciate each day (Carbaugh, 2015). Another important factor influencing the real exchange rate is productivity as suggested by Balassa and Samuelson (1964). It was established that productivity growth translated to an appreciation in the real exchange rate, particularly when focused in the traded sector of an economy.

The real exchange rate and its ability to deliver optimum growth are affected by factors such as commodity prices. Africa is richly endowed with natural resources as it houses a third of the world's mineral reserves and a tenth of global oil reserves. The commodities found across the African continent are diverse, from cotton, coffee, diamonds, oil, and gold, uranium in Niger, phosphates in Togo and iron ore in Mauritania (Deaton, 1999). These countries are greatly dependent on international commodity prices which in turn

attach their domestic economic activities to the impulses of commodity prices (Osigwe, 2015). Commodity prices sometimes result in macroeconomic instability in developing countries; the reliance of these economies on natural resources increases the likelihood of instability in the economy.

It is against this background that this study focuses on the following:

- The Real Exchange Rate and Macroeconomic Fundamentals
- The Balassa-Samuelson Effect
- Real Exchange Rate Overshooting
- The Real Exchange Rate and Commodity Prices
- Real Exchange Rate Misalignment

Previous studies have explored these issues in relation to the real exchange rate, however, these findings can hardly be generalised as a case for Africa as a region since most of these are country specific in nature. Also, the study is one of the few that explores real exchange rate misalignment and the resulting impact on the economic performance for a panel of African countries.

1.3. Research Questions

To achieve the desired aim of the study, the following research questions were answered:

- What are the potential fundamental determinants of real exchange rates in selected African countries?
- Does the Balassa-Samuelson effect hold for the selected African countries?
- Do real exchange rates overshoot in African countries?
- What is the effect of commodity price fluctuations on the real exchange rate of selected African countries?
- Is the real exchange rate misaligned and what are the effects of real exchange rate misalignment on economic performance?

1.4. Objectives of the Study

The main objective of this study is to investigate the determination of real exchange rate in selected African countries.

The specific objectives of the study are to:

- Investigate the real exchange rate as a function of macroeconomic fundamentals.
- Test for the Balassa-Samuelson effect in selected African countries.
- Empirically examine the issue of real exchange rate overshooting in African countries.
- Determine the effect of commodity price fluctuations on the real exchange rate of selected African countries.
- Derive real exchange rate misalignment and test its effects on economic performance.
- Make policy recommendations based on empirical findings

1.5. Rationale of the Study

This study is important because it contributes towards the ongoing conversation on exchange rates by broadening the scope of exchange rate studies and exploring in-depth issues such as exchange rate overshooting in the African context. The inclusion of variables such as productivity and the exploration of real exchange rate misalignment highlight the need and importance of proper management of monetary policies by the relevant authorities in African countries. Secondly, the study employs panel data analysis, the utilisation of panel data is important because it captures various factors affecting exchange rates in the context of Africa. Lastly, this study is imperative given the efforts by monetary authorities in African countries to ensure the attainment of desirable exchange rate levels to spur growth in their respective economies.

1.6. Research Paradigm

The study was informed by the positivism research paradigm. This paradigm employs a systematic and scientific approach to research. The philosophy upheld by positivists is of a deterministic nature; in it, causes influence outcomes. In this way, the issues considered

in this paradigm should mirror the need to recognise and evaluate the causes that impact results (Creswell, 2013). The motivation behind research for the positivist is to describe and explain occurrences of the world. Normally, positivists gather numerical data which is appropriate for statistical analysis. It is for that reason that their methodology is defined as quantitative (Mukherji and Albon, 2014). Knowledge created through positivism is carefully considered through observations and measurements of the objective reality that exists in the world. It is principal therefore to create numeric measures of observations (Creswell, 2013). Positivism is a philosophy that subscribes to the notion that only factual knowledge attained through observation and measurement is reliable. In its pure form, positivism questions reasoning and theory as valid for establishing reliable knowledge. The contemporary perspective embraced the logical extension of facts and it came to be known as logical positivism, a popular philosophy in the 20th century. Logical positivism influenced economics with advocates such as Wassily Leontief, Milton Friedman at the helm (Ethridge, 2004). Positivism influenced economics by encouraging the development of new statistical and econometric techniques as this paradigm emphasises on measurement and quantification. Likewise, it has encouraged economic thinking to emphasise on objectivity in the practice of economics and economic research (Ethridge, 2004).

1.7. Research Methodology

The research methodology is composed of the following:

- The study was conducted in a selection of African countries and it adopts the panel data approach.
- The selection of countries studied was based on the availability of data.
- Secondary data was derived from the Quantec database and the period covered ranges from 1980 and 2016.
- Careful consideration of variables used in the study was based on theoretical literature.
- Extensive review of the literature on the determinants of the real exchange rate, the Balassa-Samuelson effect, real exchange rate overshooting, the real

exchange rate and commodity prices and the resulting real exchange rate misalignment.

- The application of the relevant cointegration techniques on established theoretical models.
- An investigation of the real exchange rate misalignment on economic performance using panel data cointegration tests.

1.8. Overview of Topics under Study

- **The Real Exchange Rate and Macroeconomic Fundamentals**

Edwards (1986) theoretically and empirically analysed real exchange rate determination by constructing a two-period real inter-temporal optimisation model with consumers and producers. The model served to determine the course of equilibrium real exchange rates (Kahsay and Handa, 2011).

Edwards' model mainly captured the conventional elements of a small developing economy (most of African countries are classified as developing) which included the existence of exchange and trade controls. The model assumed that the small economy produced and consumed two goods (tradables and non-tradables), importables and exportables were combined into one category, the government sector consumed both tradables and non-tradables and the country held both domestic and foreign money. In this model, the fundamental or real variables could have roles in influencing the long-run equilibrium real exchange rate, while both real and nominal factors influenced the actual real exchange rate in the short-run (Chowdhury, 1999).

Edwards (1986) cited various fundamentals that affect the real exchange rate, such as the terms of trade, government expenditure, trade restrictions, exchange and capital controls, technological and productivity improvement (which captures the Balassa-Samuelson effect). The relationship between the equilibrium exchange rate and the fundamentals was expressed as follows:

$$Ineq_t = \beta_0 + \beta_1' PX_t \quad (3)$$

Where e_{q_t} is the equilibrium real exchange rate, β_0 and β_1' are the vector of parameters to be estimated, PX_t is a vector of the components of fundamentals that are permanent. The empirical estimation of equation (3) is challenging to determine due to difficulties in observing the equilibrium real exchange rate. β_1' and PX_t are estimated by means of the actual values of the real exchange rate and fundamentals which result in an aligned empirical model:

$$\ln RER_t = \beta_0 + \beta_1' X_t + \varepsilon_t \quad (4)$$

Where RER is the observed or actual real exchange rate, X_t is the vector of fundamentals and ε_t is the error term assumed to be stationary with a mean of zero (Eita, 2007).

This study selected fundamentals relatively common to all countries in influencing the real exchange rate based on Edward's model. The model adopted in this study is therefore based on Edward's original model known as the fundamental approach to real exchange rate determination.

- **The Balassa-Samuelson Effect**

The Balassa-Samuelson hypothesis was a result of the augmentation of the Purchasing Power Parity (PPP). Balassa (1964) questioned the validity of the PPP as a theory that explained the determination of the equilibrium exchange rate (Moosa, 2012). Balassa and Samuelson both argued that labour productivity differentials between tradable and non-tradable sectors would result in changes in real costs and relative prices thus leading to divergences in the exchange rate adjusted national prices (Asea and Mendoza, 1994).

Under the Balassa-Samuelson effect therefore, a country in possession of a larger relative productivity advantage in tradables over its relative productivity advantage in non-tradables ought to have a higher real exchange rate (Mercereau, 2003).

Under the Balassa-Samuelson theory, the economy produces tradables and non-tradable goods with a Cobb-Douglas production function in two sectors (tradable goods and non-tradable goods) denoted by superscripts T and N:

$$Y^T = A^T (L^T)^{\theta^T} (K^T)^{1-\theta^T} \quad (5)$$

$$Y^N = A^N (L^N)^{\theta^N} (K^N)^{1-\theta^N} \quad (6)$$

Where Y is sectoral output; and L, K and A are labour, capital and productivity, respectively. Assuming perfect competition in both sectors, perfect capital mobility across the sectors and internationally, and perfect labour mobility between the sectors, profit maximisation implies;

$$R = (1-\theta^T)A^T (K^T / L^T)^{-\theta^T} = P(1-\theta^N)A^N (K^N / L^N)^{-\theta^N} \quad (7)$$

$$W = \theta^T A^T (K^T / L^T)^{1-\theta^T} = P\theta^N A^N (K^N / L^N)^{1-\theta^N} \quad (8)$$

Where R is the rental rate of capital determined in world markets; W is the wage rate (in terms of tradables) and P is the relative price of non-tradables. The key result of Balassa-Samuelson hypothesis is that relative price changes are driven entirely by the production side of the economy (Romanov, 2003).

A shortcoming of the initial Balassa-Samuelson theory was that, it was based purely on the supply side of the economy and demand conditions were entirely excluded (Vinals, 2004). However, as the theory evolved, some modifications were made. Rogoff (1992) formulated the demand side of the economy, which allowed researchers to study the effects of the demand side (such as government spending) on long-term relative price levels between countries, in addition to the effect of relative productivities and intensities of factors on price levels.

- **Real Exchange Rate Overshooting**

Overshooting is defined as the short-run extreme fluctuations in exchange rates resulting from the different speeds of adjustment across markets (Naknoi, 2003). The idea of

exchange rate overshooting was first presented by Dornbusch (1976). He contended that because prices of the goods were sticky while exchange rates were more volatile, they would overshoot their real equilibrium value (Brandl, 2016). The focus of the theory of overshooting exchange rates is on the impact of the raised spending on bonds. The argument with regards to this increased spending is that, this leads to higher bond prices and thus, lower interest rates. Low interest rates in a country in comparison to other countries results in capital leaving that country. This occurs until a country's currency is low and is expected to appreciate by the extent to which its interest rate is below that of other countries. For the currency to be expected to appreciate, the exchange rate must overshoot, moving lower than its eventual equilibrium level. This means that prices of traded goods, which move with the exchange rate, increase in the price index (Levi, 2009).

The overshooting theory is dependent upon certain assumptions; an infinite interest elasticity of demand for money resulting in the adjustment of exchange rate in short-run equating to the long-run adjustment and; imperfect capital mobility resulting in the undershooting of the long-run value of the exchange rate. However, the theory captures the effects of major turning points in monetary policy (Tu and Feng, 2009).

In essence, overshooting models contend that the overreaction of foreign exchange rates is temporal, and it occurs due to fluctuations in monetary policy as a way of compensating for sticky prices in the economy. Therefore, there is increased volatility in the exchange rate due to overshooting. Volatile exchange rates influence the tradable goods sector and may result in unstable aggregate demand and prices. This study examined real exchange rate overshooting in African economies with the aim of informing monetary policy decisions and the channels through which general prices and economic activity are affected.

- **Real Exchange Rates and Commodity Prices**

The breakdown of the Bretton-Woods system led to increased nominal and real exchange rates among leading currencies and increased volatility in the nominal and real prices of internationally traded commodities. Policymakers and economists state that acute variability in real commodity prices may in turn result in problems in developing and

industrial countries. Primary commodities are the dominant commodities in developing countries therefore changes in world commodity prices are most likely to explain a vast amount of the movement in their terms of trade (Sahay, Céspedes and Cashin, 2002).

Normally, variations in commodity export prices have an influence on real exchange rate behaviour. An increase in commodity exports leads to real appreciation of the domestic currency, with the degree of the appreciation reliant on the perception of the change in export prices, that is, whether it is temporary or permanent in addition to other factors. Most empirical studies about the interaction between commodity export prices and real exchange rates have their focus on the long-run real impact of changes in export prices and investigations of the impact of resource-based export booms on the real exchange rate, wages, employment and output in the long-run. All this while ignoring the impact of changes in commodity export prices on short-run monetary effects, which spill over to the real exchange rate (Edwards, 1986).

Bodart, Candelon and Carpentier (2011) are some of the scholars that have provided evidence of a long-run association between real exchange rates and commodity prices, especially for developing countries specialising in the export of a main primary commodity.

1.9. Real Exchange Rate Misalignment

The study tests for real exchange rate misalignment and the resultant impact on economic performance, therefore this section gives an overview of what real exchange rate misalignment entails:

Edwards (1988) brought to the fore the consensus about real exchange rate misalignment being a cause of acute macroeconomic disequilibria. The consensus was that, misalignment would result in the correction of external imbalances (that is, current account deficit) requiring both demand management policies and a real exchange rate devaluation. According to Razin and Collins (1997) real exchange rate misalignment refers to a deviation of a country's real exchange rate from a perceived ideal real exchange rate. RER misalignment impacts on economic performance with an

overvaluation deterring economic growth while an undervaluation is advantageous for growth.

Edwards distinguished between two types of misalignment: macroeconomic induced misalignment which transpires because of inconsistencies between macroeconomic, particularly with monetary policies and the official nominal exchange rate system, this leads to the departure of the real exchange rate from its actual equilibrium value. The second type of misalignment is known as structural misalignment which occurs when there are changes in the real determinants (fundamentals) of equilibrium; that is, changes that are not translated in the short-run into actual changes of the real exchange rate (Edwards, 1987).

1.9.1. The Impact of Real Exchange Rate Misalignment on Economic Performance

Overvaluations and undervaluations of the real exchange rate present different effects on economic growth. An overvaluation of the real exchange rate has a negative effect on economic growth, especially for developing countries that normally experience large overvaluations. The impact of undervaluations on economic growth is negligible. An undervaluation of the real exchange rate occurs when it depreciates more than its equilibrium rate while an overvaluation occurs when the real exchange rate exceeds this real rate (Jha, 2003).

An overvalued exchange rate affects economic growth in the following ways:

- Discrimination against exports because a substantial percentage is paid in domestic currency and the overvalued exchange rate decreases the incentives and capabilities of exporters to compete in foreign markets. Foreign exchange rate receipts and a country's capacity to acquire imports are in turn hindered.
- Increased pressure from foreign companies for import-competing industries thus leading to requests for protection against imports from industrial and agricultural lobbies.
- The advancement in productivity slows down due to the disadvantages confronting export sectors.
- Domestic citizens anticipate a devaluation thereby inducing capital flight.

- There may be inefficient rationing and allocation of foreign exchange by the government.
- The tightening of the monetary policy in a bid to protect the overvalued exchange rate can result in a recession (Drabek, 2001).

There have been various studies conducted to explore the impact of the real exchange rate (RER) misalignment on economic growth employing various methods. Musyoki, Ganesh and Pundo (2014) examined this relationship in Kenya using the Johansen Cointegration and Error Correction Model. The study found that the economic growth in the country declined due to misalignment. Aguirre and Calderón (2005) explored the resultant impact of growing real exchange rate misalignments and their volatility for sixty countries. Dynamic panel data methods were applied, and the findings were that real exchange misalignments hindered growth in a non-linear way as the deteriorations in growth were large in proportion to larger sizes of misalignments. Razin and Collins (1997) employed regression analysis to establish the link between real exchange rate misalignments to country growth experiences. The study found that very high overvaluations seemed to be linked to sluggish economic growth, while minor to high (not excessively high) undervaluations seemed to be linked to fast economic growth. Toulaboe (2011) tested the effect of exchange rate misalignment on economic growth in thirty-three developing countries and the study revealed a negative relationship between average real exchange rate misalignments and economic growth.

1.10. Ethical Considerations

There were no ethical considerations related to the participation of human and animal subjects in this study. The study however adhered to ethical guidelines pertaining to research at the North-West University.

1.11. Limitations of the Study

A limitation of this study was in relation to the data employed. The study used secondary data which therefore confined the time frame of the study in accordance to data availability. A problem associated with secondary data is that the quality of the data cannot be controlled or ascertained.

Despite the limitation stated above, the findings of the study are not in any way invalidated.

1.12. The Organisation of Chapters

1.12.1. Outline of the Study

The study is organised into four independent articles. Each article addresses an aspect of real exchange rates in selected African countries. Each article presents an introduction, literature review (theoretical and empirical), empirical models drawn from literature, findings and conclusions. All articles conclude with policy recommendations based on empirical findings.

Chapter two presents the real exchange rate in a panel of African countries as a function of certain macroeconomic fundamentals. The study further derived real exchange rate misalignment and assessed the effects of real exchange rate misalignment on the economic performance of these countries. Chapter three studied the Balassa-Samuelson effect, the Balassa-Samuelson is concerned with the relationship between the rise in productivity in the traded goods sector and the appreciation of the real exchange rate. Further, real exchange rate misalignment and assessment of the effects of misalignment on the economic performance of these countries was conducted

Chapter four explores the phenomenon of real exchange rate overshooting. The importance of exchange rates has since encouraged a plethora of studies about overshooting exchange rates to be conducted and this study is no exception. This research created a model that traced the magnitude of real exchange rate overshooting in African countries. The study further derived real exchange rate misalignment and assessed the effects of this misalignment on the economic performance of these countries.

Chapter five investigated the relationship between the real exchange rate and commodity prices in African countries and further derived real exchange rate misalignment.

Finally, chapter six presents a synopsis of the study and concluding comments on the key findings of this study and offers policy recommendations.

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Chapter Two

Estimating the Equilibrium Real Exchange Rate Using Macroeconomic Fundamentals, Misalignment and the Impact of Misalignment on Economic Performance in a Selection of African Countries

Abstract

This study explored the relationship between the real exchange rate and macroeconomic fundamentals for a selected panel of African countries. Two models were estimated for time periods 1995 to 2016 and 1990 to 2016. The study contributed not only through estimating the equilibrium real exchange rate but derived real exchange rate misalignment and further tested the effects of real exchange rate misalignment on economic performance. This was achieved by computing permanent values of the fundamentals using the Hodrick-Prescott (HP) filter. Employing numerous tests, the results revealed significant relationships between the real exchange rate and fundamentals (inflation, government expenditure and terms of trade). Additionally, both negative and positive coefficients for real exchange rate misalignment for the different models and samples were revealed, indicating periods of undervaluation and overvaluation of the real exchange rate.

Keywords: Real Exchange Rate, Real Exchange Rate Misalignment, Macroeconomic Fundamentals Economic Growth, Panel Data

2.1. Introduction

The real exchange rate (RER) has gained increasing attention over the years (Elbadawi and Soto, 1997). Today, the real exchange rate is predominantly the focus of debates on economic development, growth strategies, structural adjustment and economic stabilisation. Economic research has further embarked on missions to uncover its empirical determination, the calculation of its equilibrium path, the assessment of its misalignment and the estimation of a set of fundamentals consistent with internal and external balances.

The real exchange rate is a key relative price in any economy, hence, its importance and emphasis on the maintenance of its stability. In the same vein, the real exchange rate is a popular real target in developing countries. Countries employ strategies to control the level of the real exchange rate allowing for domestic or external shocks to attain a different level which is normally depreciated (Reinhart and Vegh, 1995).

Economists have thought exchange rate variations to be dictated by changes in one or more of the important economic variables proposed by the main theories advocated in the leading schools of economic thought. However, there has been no consensus about the fundamentals that should determine exchange rates. Moreover, it has been acknowledged that exchange rates could be disproportionate to fundamentals for substantial timeframes (Cencini, 2005).

Thus, the determination of the real exchange rate through macroeconomic fundamentals has been an enduring debate in literature. The ability of macroeconomic models to explain exchange rates has been questioned since the early 1980s (Devereux, 1997). Studies in international economics have struggled to establish the link between floating exchange rates to macroeconomic fundamentals such as money supplies, outputs, and interest rates (Engel and West, 2005).

This puzzle is about the weak short-run relationship between the exchange rate and its macroeconomic fundamentals; for example, fundamentals such as interest rates, inflation rates and output do not elucidate the short-term volatility in exchange rates (Evrensel, 2013). Despite this predicament, the largely unstable relationship between exchange

rates and macroeconomic fundamentals is well documented in literature (Bacchetta, Van Wincoop and Beutler, 2009; Engel and West, 2005; Sarno and Schmeling, 2013).

The standard models of exchange rates and macroeconomic fundamentals propose that exchange rates are determined by expected future fundamentals thereby suggesting that current exchange rates have predictive information about future fundamentals (Sarno and Schmeling, 2013). They provide evidence that exchange rates forecast fundamentals, which infers that fundamentals are a crucial determinant of exchange rates (Sarno and Schmeling, 2013). Exchange rate theories by Engel and West (2005) expressed that fundamental variables influenced the exchange rate but floating exchange rates between countries with generally comparable inflation rates were estimated as random walks. Engel and West (2005) envisaged that their findings would change the landscape of the exchange rate debate as they found an inverse link between fundamentals and the exchange rate. This implied that exchange rates helped forecast the fundamentals. They further concluded that exchange rates and fundamentals are linked in a way which is consistent with asset pricing models of the exchange rate.

However, empirical models applied in the late 1980s tended to neglect the likelihood of the presence of a long-run relationship between the fundamentals and the exchange rate. In the beginning of the 1990s, structural models were employed to test for this long-run relationship. An observation concerning the structural models which had their premise in cointegration relationships was made; they were seen to improve the evidence in favour of predictability in the long-run (MacDonald and Taylor 1993, 1994).

Other economic studies have documented the association between high volatility of the exchange rate and macroeconomic fundamentals. Bacchetta, van Wincoop and Beutler (2009) attributed this high volatility to large and recurrent changes in the relationship between the exchange rate and macro fundamentals; these occur when structural parameters in the economy are obscure and transform gradually. Bacchetta, Van Wincoop and Beutler (2009) concluded that the reduced form relationship between exchange rates and fundamentals was determined by expectations of parameters and not by structural parameters.

Where the real exchange rate is concerned, for a typical African country, their economies are dominated by unstable and uncompetitive exchange rates and equally unstable macroeconomic fundamentals. The imbalances in some instances may be exacerbated by changes in the macroeconomic fundamentals which may lead to real exchange rate misalignment. Real exchange rate misalignment in turn influences economic performance.

Given the pertinence of the real exchange rate, fundamentals and real exchange rate misalignment, various studies have been conducted (Miyajima, 2007; Ozsoz and Akinkunmi, 2012; Mkenda, 2001). However, most of the research on real exchange rate behaviour generally overlooks the impact of real exchange rate misalignment on economic performance. Most research studies do not consider real exchange rate misalignment. The limited studies such as (Eita and Sichei (2014), Ndlela (2012) and Mkenda (2001)) were based on single countries that cannot be generalised to Africa. This study fills this gap in literature by investigating real exchange rate misalignment and economic performance in a panel of selected African countries (Algeria, Cameroon, Central African Republic, Equatorial Guinea, Gabon, Gambia, Ghana, Lesotho, Morocco, Nigeria, South Africa, Sierra Leone, Togo, Tunisia, Uganda and Zambia). Moreover, the study extends the previous analysis by Ghura and Grennes (1993) and uses high frequency data, that is, annual data from 1990 to 2016.

The study is organised as follows. Section 2.2 presents the literature review. Sections 2.3 and 2.4 present the methodology and the empirical models estimated. Sections 2.5 to 2.7 present and explain the empirical results, while the conclusion and recommendations are presented in Section 2.8.

2.2. Literature Review

The period from 1973 – 1975 saw economists creating new theories of the exchange rate (Bilson and Marston, 1984). Therefore, the theories of exchange rates have evolved over the past years. Literature offers several theoretical and empirical models of exchange rates. This section presents the theoretical and empirical literature of the real exchange rate.

2.2.1. The Theory of Real Exchange Rates

Because of the failure of the Bretton Woods system, major currencies around the globe began to float against each other. During this episode, the monetary approach which assumed that the purchasing power parity exchange (PPP) rate held constantly was the main method of determining exchange rates (Taylor and Taylor, 2004).

In 1978, Frenkel concurred that the PPP was constant and further promoted the idea of the PPP being considered as a theory of exchange rate determination. The notion that the PPP was useful in providing a guide to the general trend of exchange rates was brought forward. But the mid-1980s brought a wave of doubt about the PPP as researchers reached a conclusion opposite to the original notion. This cast a shadow of doubt on the role of PPP as a rule-of-thumb predictive model and its position as equilibrium condition. The PPP had supposedly collapsed (Lothian and Taylor, 1997).

In view of this theory, numerous empirical studies were conducted to establish the validity of the purchasing power parity; moreover, investigations into the monetary approach and its impact on the exchange rate were undertaken with encouraging results. These results were attributed to the stability of the US dollar in the early days of the floating system. Thereafter, the US dollar became increasingly volatile and this exposed the inability of the PPP to be constant thus the monetary approach was rejected. The collapse of the PPP was identified easily through the examination of the real exchange rate. However, the PPP still presented a certain measure of the real exchange rate relating to PPP, this as well as the changes in the real exchange rate still need to reflect deviations from PPP (Taylor and Taylor, 2004).

The PPP real exchange rate (${}^e ppp$) was defined as equal to the nominal exchange rate (E) corrected (that is, multiplied by the ratio of the foreign price level (P^*) to the domestic price level: ${}^e ppp = EP^* / P$ depending on whether P and P^* are consumer price indexes or producers price indexes; ${}^e ppp$ thus amounts to the relative price of foreign to domestic consumption of production of baskets. This definition of real exchange rates was employed by some policymakers due to the challenges experienced in

explaining the relative price of tradables to non-tradables (Edwards, 1988). Studies like Abuaf and Jorion (1990) suggested that long-run PPP might hold and further called into question the notion that real exchange rates followed a random walk. Other studies like Isard (1978) had cast doubt on the ability of the PPP as a theory to present the correct predictions of exchange-rate behaviour in the short run.

Ricci (2005) further discredited the PPP theory by stating that indications in literature were that the PPP was an inappropriate model for ascertaining equilibrium exchange rates; this was largely due to the slow pace at which real exchange rates returned to a constant level (which is the long-run equilibrium as implied by the PPP assumption). Literature has largely focused on the equilibrium relationship between the real exchange rate and various economic fundamentals and has moved away from PPP-based measures of the equilibrium exchange rate (Ricci, 2005).

Some of the economic fundamentals identified for developing countries include commodity price movements (or the terms of trade), productivity and real interest rate differentials, measures of openness of the trade and exchange system, the size of the fiscal balance or of government spending, and net foreign assets. These variables are employed based on a simple neoclassical theoretical framework. This framework is of the view that prices of tradable goods are equalised across countries and aims to depict the reflection of changes in the real exchange rate in relation to the relative price of non-tradables across countries. In most instances, the PPP neglects the evolution of fundamentals thus rendering it inaccurate. The PPP must then be substituted by the natural real exchange rate produced by the fundamentals (Stein, 1994).

2.2.2. The Real Exchange Rate and Macroeconomic Fundamentals

The fundamental determinants of the real exchange rate are the real variables that have an influence in determining a country's internal and external equilibrium. These variables and the real exchange rate mutually determine the internal and external equilibrium position of a country. In reality, there are an extensive number of such factors, but analytical and policy discussion only focuses on the most vital. Real exchange rate fundamentals have been separated into two classes: external fundamentals which encompass international prices and world interest rates amongst other factors and

domestic fundamentals which encompass import tariffs, government expenditure amongst other factors (Edwards, 1987).

Edwards (1988) developed a model for real exchange rate determination where both real and nominal factors played a role in the short run. The long-run only employs real factors or fundamentals which impact on the real exchange rate. The model contained developing economy macroeconomic features such as exchange controls, trade barriers and a freely determined parallel market for foreign financial transactions.

Three goods are considered in the model: exportables, importables and non-tradables in a small open economy setting. The long-run equilibrium real exchange rate is defined as a function of the fundamentals and changes in these fundamentals result in changes in the equilibrium RER; some of these changes include increment in tariffs and terms of trade disturbance.

The model is presented as follows:

Portfolio Decisions:

$$A = M + \delta F \quad (1)$$

$$a = m + \rho F, \text{ where } a = A / E; M = M / E; \rho = \delta / E \quad (2)$$

$$m = \sigma(\dot{\delta} / \delta) \rho F; \quad (3)$$

$$\dot{F} = 0 \quad (4)$$

Demand Side:

$$p_M = EP^* + r; \quad (5)$$

$$C_M = C_M(e_M, a) \quad (6)$$

$$C_N = C_N(e_M, a) \quad (7)$$

Supply Side:

$$Q_X = Q_X(e_X); \quad (8)$$

$$Q_N = Q_N(e_X); \quad (9)$$

Government Sector:

$$G = P_N G_N + EP_M^* G_M \quad (10)$$

$$\frac{EP_M^* G_M}{G} = \lambda \quad (11)$$

$$G = t + \dot{D} \quad (12)$$

External Sector:

$$CA = Q_X(e_X) - P_M^* C_M(e_M, a) - P_M^* G_M \quad (13)$$

$$\dot{R} = CA \quad (14)$$

$$\dot{M} = \dot{D} + ER \quad (15)$$

$$e = \alpha e_M^* + (1 - \alpha) e_X = \frac{E[\alpha P_M^* + (1 - \alpha) P_X^*]}{P_N} \quad (16)$$

Equation 1 defines the total assets A in domestic currency as a sum of foreign money and domestic money. Equation 2 defines real assets in terms of the exportable good. Equation 3 is the portfolio composition equation. Equation 4 determines that capital mobility is inexistent and that no commercial transactions are subject to the financial state \mathcal{S} . Equation 5 to 9 summarises the demand and supply notion, e_M and e_X are the domestic prices of importables and exportables with respect to non-tradables. Equation 10 and 11 summarises the government sector, where G_N and G_M are consumption of M and N . Equation 12 is the government budget constraint. Equation 13 to 16 summarises the external sector. The attainment of a sustainable long-run equilibrium occurs when the non-tradable good market and the external sector (current account and balance of payments) are concurrently in equilibrium.

2.2.3. Empirical Studies

The real exchange rate is a key price in many economies and this has prompted debates and discussions, particularly for developing countries; most of which are small open economies. This has also encouraged a plethora of studies about the real exchange rate in a bid to discover the properties of the real exchange rate and how it behaves in different economies. Of critical importance is the maintenance of the real exchange rate equilibrium. An imbalance or disturbance in the equilibrium level normally referred to as real exchange rate misalignment, can have negative implications for the economic performance of a country.

2.2.3.1. Real Exchange Rates and Macroeconomic Fundamentals

Ricci, Milesi-Ferretti and Lee (2008) estimated a panel cointegrating relationship between real exchange rates and macroeconomic fundamentals for forty-eight industrial countries and emerging markets. Improved measures for productivity differentials, external imbalances, and commodity terms of trade were used and the results were a robust positive association between the CPI-based real exchange rate and commodity terms of trade. Productivity growth differentials between traded and non-traded goods was small yet statistically significant. The study placed emphasis on the significance of employing productivity data for both tradables and non-tradables with respect to trading partners to substitute for the Balassa-Samuelson effect.

Faruqee (1995) explored the causes of long-run movements in the real exchange rate for the United States and Japan. The study applied a form of the macroeconomic balance approach with emphasis on the stock-flow determination of the real exchange rate compatible with internal and external balance to cater for long-run relative price movements. Post war data for both countries was used in a cointegration analysis which is normally associated with long-run co-movements between the real exchange rate and a set of fundamental determinants. The tests conducted for both countries inferred a deterministic long-run relationship between the structural components in the current and capital accounts and the real exchange rates.

In a study involving exchange rates and emerging economies, Edwards and Savastano (1999) focused on; merits of alternative exchange rate regimes, the extent to which purchasing power parity holds in the long-run in these countries; and models to assess real exchange rate overvaluation. They reviewed econometric models used in emerging economies and instances of real exchange rate misalignment. With specific reference to misalignment, the observation was that in the single equation econometric models normally employed in the context of these countries, the real exchange rate was described as the relative price of tradable to non-tradable goods.

Burange, Ranadive and Karnik (2013) sought to establish the variables influencing the real exchange rate in India. The study considered fundamentals such as productivity differences and government expenditure. The Autoregressive Distributed Lag (ARDL) bounds testing approach revealed the presence of a long-run relationship between real exchange rates and the fundamentals for the period of 1993Q1 to 2011Q4. The results were an affirmation of an expected theoretical relationship between the various fundamentals and the real exchange rate in the long-run.

Bjørnland (2003) explored the possibilities of an equilibrium real exchange rate in Venezuela with the aim to ascertain the relative ability of demand and supply shocks in explaining real exchange rate fluctuations. To achieve this, a structural vector autoregression (VAR) model was used. Long-run restrictions on a VAR model for Venezuela were imposed leading to the identification of four structural shocks: nominal demand, real demand, supply and oil price shocks. Findings revealed a positive oil shock leading to the appreciation of the real exchange rate and a supply shock resulting in depreciation of the real exchange rate. Furthermore, a positive real demand shock resulted in an appreciation of the real exchange rate as a result; there was a slow increase of prices. The evidence that the behaviour of the real exchange rate is unrelated to PPP in Venezuela is brought forth in this study. Hence, the PPP hypothesis cannot be used to forecast any overvaluation and undervaluation of the exchange rate.

Zhang (2001) estimated the behavioural equilibrium exchange rate and the resultant misalignment in China based on the theory of equilibrium real exchange rate. The Johansen cointegration method was employed in the estimation of the equilibrium real exchange rate and the resulting misalignment. Results revealed that a rise in investment and openness of the economy led to the depreciation of the real exchange rate. Whereas a rise in government expenditure and export led to the appreciation of the real exchange rate. Chronic overvaluation in China's central planning period is evident in the study; however economic reforms brought the real exchange rate closer to equilibrium. These results provided some evidence of China's proactive exchange rate policy which sought to employ the nominal exchange rate as a policy tool, as a means of attaining targets in the real sector or a real exchange rate target.

Mathisen (2003) studied the equilibrium real exchange rate in Malawi for the period of 1980 to 2002. The real exchange rate was presented as a function of fundamentals drawn from economic theory. Edward's theoretical model was adopted to model the relationship between real exchange rates and fundamentals in Malawi. Fundamentals cited included: government consumption, investment, terms of trade and technological progress amongst others. The results revealed favour of the equilibrium approach to real exchange rate determination.

Miyajima (2007) evaluated competitiveness in Namibia. The findings were a real effective exchange rate in equilibrium at the time. Additionally, suggestions on improving competitiveness of the country were stated in the study. Exchange rate misalignment was derived, and findings showed that Namibia experienced great misalignments in 1990 which weakened in the 1990s and increased in the 2000s.

Ricci (2005) applied the real effective exchange rate logarithmic terms as a function of the real interest rate relative to trading partners, the real GDP per capita relative to trading partners (a proxy for the Balassa-Samuelson effect), logarithm of real commodity prices and openness amongst other variables in the study about the real exchange rate performance in south Africa. The study found a real exchange rate close to equilibrium level during the 1990s and changes in fundamentals could accounting for its decline.

Ozsoz and Akinkunmi (2012) assessed the determinants of real exchange rates for the Nigerian Naira. The study proposed oil prices, broad money supply, level of foreign reserves and interest rate differentials with trading partners as possible predictors of the long-run Naira equilibrium real exchange rate. Furthermore, the study employed the behavioural equilibrium exchange rate approach as means of identifying misalignments in the real Naira rate. Findings of the study revealed an undervaluation of the Naira at the end of 2010. Mkenda (2001) investigated the main determinants of the real exchange rate in Zambia by employing cointegration analysis. The tested fundamentals (terms of trade, trade taxes etc.) were found to be influencers of the real exchange rate for exports in the long-run and the internal real exchange rate was influenced by terms of trade, investment share, and the rate of growth of real GDP in the long-run. Additionally, the study derived exchange rate misalignment and found overvalued exchange rates in some periods.

Eita and Sichei (2014) studied the equilibrium real exchange rate for Namibia for the period 1998 to 2012 by means of quarterly data using the Vector Error Correction Model (VECM). The study found an increment in the ratio of investment to GDP and resource balance linked with a subsequent appreciation of the real exchange rate. The terms of trade resulted in the real exchange rate depreciation implying that the substitution effect dominated the income effect. The study further revealed periods of undervaluation and overvaluation of the real exchange meaning that real exchange rate misalignment occurred in some periods.

With the real exchange rate being a key policy variable in the South African open economy, Aron, Elbadawi and Kahn (1997) presented possibly the first formal definition and estimation of the fundamental (long-run) and short-run influences in a model for the real exchange rate in South Africa. They employed a single equation cointegration model to investigate the short-run and long-run equilibrium determinants of the quarterly real exchange rate in 1970:1 to 1995:1. The macroeconomic balance approach was used to define the equilibrium real exchange rate with focus on the concurrent realisation of internal and external balance for given sustainable values of variables such as taxes, terms of trade, trade policy, capital flows and technology. The model employed in the

study revealed that, over time, the real exchange rate is not constant but it too changes in an array of fundamentals and shocks to the economy.

2.2.3.2. Real Exchange Rate Misalignment and Economic Performance

Rodrik (2008) tested RER misalignment and growth in one hundred and eighty-four countries from 1950 to 2004 using an index as a measure of the degree of RER undervaluation. The Balassa-Samuelson effect was taken into consideration through the employment of real per capita GDP. The study found that overvaluation impeded growth while undervaluation promotes it. Abida (2011) explored real exchange rate misalignment and growth in Tunisia, Algeria and Morocco using the Fundamental Equilibrium Exchange Rate (FEER) approach to derive misalignment. Findings of the study showed negative misalignment. Similarly, Elbadawi, Kaltani and Soto (2012) found that misalignment negatively affected growth in a study about aid, real exchange rate misalignment, and economic growth in Sub-Saharan Africa. Sallenave (2010) obtained similar findings in a study about the growth effects of real effective exchange rate misalignments for the G20 countries.

Vieira and MacDonald (2012) studied the effect of real exchange rate misalignment on long-run growth from 1980 to 2004 by approximating a panel data model for a set of ninety-nine countries. Measures of real exchange rate misalignment were created by using approximations of the equilibrium real exchange rate. The results revealed positive coefficients for real exchange rate misalignment meaning that a depreciated (appreciated) real exchange rate aided (impaired) long-run growth.

Ghura and Grennes (1993) studied the incidences of real exchange rate misalignment and the resultant impact on economic performance for thirty-three Sub-Saharan African countries over the time span of 1972 to 1987. The study found an inverse relationship between the real exchange rate (RER) misalignment and economic performance. Additionally, the study indicated that macroeconomic instability contributed to slower growth whilst high misalignment was similarly associated with high macroeconomic instability levels. On the one hand, low levels of RER misalignment and instability translated to improved economic performance.

Ndlela (2012) investigated the relationship between real gross domestic product growth and real exchange rate misalignment for Zimbabwe and the results concretised the hypothesis of real exchange rate overvaluation being a factor in contracting economic growth in Zimbabwe. Tsen Wong (2013) explored real exchange rate misalignment and economic growth in Malaysia and found that a rise in real exchange rate misalignment resulted in a fall in economic growth. Naseem and Hamizah (2013) also investigated real exchange rate misalignment and economic growth in Malaysia with the results indicating the presence of a positive and significant relationship between RER misalignment and economic growth.

2.2.3.3. Limitations of Reviewed Studies and Contribution to Literature

The reviewed studies revealed the pertinence of the real exchange rate in various economies around the globe. Numerous studies explored various fundamentals that potentially influence the behaviour of the real exchange rate, with the concern of the effects it may pose on economic performance. Some of these reviewed studies further derived real exchange rate misalignment which impacts the on economic performance of a country Miyajima, (2007); Ozsoz and Akinkunmi, (2012); Mkenda, (2001). However, many of these studies do not test the impact of misalignment on measures of economic performance. The limited studies by Eita and Sichei (2014), Ndlela (2012) and Mkenda (2001) were based on single countries and cannot be generalised to Africa. However, Ghura and Grennes (1993) did conduct a study on Sub-Sahara African countries where the previously popular three measures of real exchange rate misalignment were employed. These measures included a measure based on the Purchasing Power Parity (PPP) (also used by Balassa (1990) and Cottani *et.al* (1990); a measure based on the official nominal exchange rates [also used by Edwards (1989) and Cottani *et.al* (1990); and a black market nominal exchange rates measure (also used by Edwards (1989, 1990).

Some of these measures have limitations, for instance, the PPP theory is insufficient in explaining the equilibrium exchange rate because real exchange rates depart for long periods from their PPP levels (MacDonald and Ricci (2002) and Siregar (2011)). Hossfeld (2010) affirmed the shortcoming of the PPP as a determinant of equilibrium exchange

rate by stating that the PPP was unable to capture the role of capital flows and other fundamental determinants of real exchange rates.

Therefore, this study makes a contribution by using the most recent data to estimate the equilibrium real exchange rate and further tests the effects of real exchange rate misalignment on economic performance. The study constructs an equilibrium real exchange rate by substituting permanent values of fundamentals into the estimated co-integrating relationship. The estimated coefficients are imposed on the permanent values of the fundamentals. The permanent values of the fundamentals were constructed using the Hodrick Prescott (HP) filter.

In macroeconomics, time series are generally considered as the sum of transitory and permanent components. The HP filter helps capture the smooth path of the trend component by maximising the sum of the squares of its second difference (Choudhary, Hanif and Iqbal, 2014). The HP is also advantageous because it is insensitive towards periods therefore, there is little arbitrariness; long-term trends fluctuate over time under the HP (Anaya, 1999). The study then proceeds to compute real exchange rate misalignment as the percentage difference between the actual real exchange rate and the equilibrium RER as in Hinkle and Montiel (1999) who interpreted misalignment as the gap between the actual real exchange rate (e) and the equilibrium real exchange rate (e^*) following Edwards (1989) and Hinkle and Montiel (1999).

The use of recent data helps capture current developments in the African region as most of the economies have undergone structural changes and exchange rate reforms. In the process, this will improve the robust estimation of the relationship between real exchange rate misalignment and economic performance. This will enable the assessment of the African economy in terms of growth, that is, whether growth is progressive or regressive to inform the formulation of suitable exchange rate policies that promote growth in the African region.

2.3. Methodology

This section presents the analytical tools employed to investigate the impact of macroeconomic fundamentals on the real exchange rate, and the resulting RER misalignment on economic performance in a panel of African countries (Algeria, Cameroon, Central African Republic, Equatorial Guinea, Gabon, Gambia, Ghana, Lesotho, Morocco, Nigeria, South Africa, Sierra Leone, Togo, Tunisia, Uganda and Zambia). Therefore, this section is organised as follows: the first section outlines the estimation of the equilibrium real exchange rate and the resulting real exchange rate misalignment and economic performance.

2.3.1. Model Specification

The empirical model adopted by this study is adapted from Edwards' (1988) fundamental approach to real exchange rate determination and variables considered as determinants of the exchange rate. In the model, Edwards expressed the equilibrium exchange rate as a function of certain fundamental factors.

Edwards specified his model as follows:

$$\log e_t^* = \beta_0 + \beta_1 \log(TOT)_t + \beta_2 \log(NGCGDP)_t + \beta_3 \log(TARIFFS)_t + \beta_4 \log(TECHPRO)_t + \beta_5 (KAPFLO)_t + \beta_6 \log(OTHER)_t + \mu_t \quad (17)$$

Where: TOT represents the external terms of trade, NGCGDP represents the ratio of government consumption on non-tradables to GDP, TARIFFS represent the proxy for the level of import tariffs, TECHPRO represents a measure of technological progress, KAPFLO represents capital inflows and outflows depending on whether the value is positive or negative, OTHER represents variables such as the investment/GDP ratio and μ , the error term.

Following the approach employed by Edwards (1988), the study adopted the following variations of Edward's model, due to data constraints, the study tests two variations of the model. The model is specified as follows:

1995-2016:

$$LRER_{i,t} = \alpha_0 + \alpha_1 LINFL_{i,t} + \alpha_2 LGOVEXP_{i,t} + \alpha_3 LTARIFFS_{i,t} + LINV_{i,t} + \varepsilon_{i,t} \quad (18)$$

Where the real exchange rate, $LRER$ is explained by import tariffs ($LTARIFFS$), government expenditure ($LGOVEXP$) and the rate of inflation, consumer prices as an annual percentage ($LINFL$), total investment as a share of GDP ($LINV$) and ε is the error term. All variables are expressed in logarithms to reduce data variability. Cointegration was used to determine the short and long-run determinants of the equilibrium RER.

1990-2016:

$$LRER_{i,t} = \alpha_0 + \alpha_1 LGOVEXP_{i,t} + \alpha_2 LFDI_{i,t} + \alpha_3 LINFL_{i,t} + LTOT_{i,t} + \varepsilon_{i,t} \quad (19)$$

Where the real exchange rate, $LRER$ is explained by terms of trade ($LTOT$), government expenditure ($LGOVEXP$) and the rate of inflation, consumer prices as an annual percentage ($LINFL$), foreign direct investment ($LFDI$), and ε is the error term. All variables are expressed in logarithms to reduce data variability. Cointegration was used to determine the short and long-run determinants of the equilibrium RER.

Edwards' (1988) model is a good representation for African countries because it is a general equilibrium model for developing countries. It involves nominal and real factors in the short run and fundamentals that influence the equilibrium real exchange rate in the long-run. In addition, determinants of the equilibrium real exchange such as changes in tariffs, terms of trade, capital account liberalisation and government consumption are specified. Due to data constraints, the models in this study employed additional variables other than those specified in Edward (1988).

For the real exchange rate variable, the study used the real effective exchange rate (REER). It is the weighted average of a country's currency in relation to an index or basket of other major currencies. The REER takes into account the influences of inflation. The

REER is calculated using a geometric average formula: $REER_t = \frac{NEER_t \times CPI_t}{CPI_t^{foreign}}$ where

NEER is the nominal effective exchange rate, CPI is the weighted average of CPI indices of trading partners. An increase in REER is appreciation and a decrease is depreciation.

Terms of trade possibly has two effects on the real exchange rate, that is, the income and substitution effects. The income effect occurs when there is an increase in export prices or a decline in import prices which in turn increases the income in an economy and the demand for non-tradables. This decreases the relative prices of tradables to non-tradables and appreciates the Real Exchange Rate (RER). On the substitution effect, an improvement in TOT due to an increment in export prices results in a depreciation of RER for certain levels of nominal exchange rate and non-tradable prices.

Tariffs refer to import tariffs which are defined as the tax levied on imported goods and services. An import tariff leads to an improvement of the current account and an appreciation of the real exchange rate (Edwards, 1987). Ravn, Schmitt-Grohe and Uribe (2012) recorded that a rise in government purchases increased output and private consumption, weakened the trade balance and depreciated the real exchange rate.

An increase in inflation results in the depreciation of the real exchange rate while a reduction in inflation normally appreciates the real exchange rate. The relationship between FDI and the RER is ambiguous because the effect on the real exchange rate is dependent on the import content of the FDI (Rochester, 2013). A rise in ratio of investment to GDP leads to increased spending and a decline in the current account therefore leading to the depreciation of the real exchange rate (Eita, 2007).

2.3.2. Real Exchange Rate Misalignment

The study tests for real exchange rate misalignment and its subsequent impact on economic performance. Real exchange rate misalignment is the deviation of the actual real exchange rate from its long-run equilibrium value (Hinkle and Montiel, 1999). After establishing the short and long-run determinants of RER, the RER misalignment is computed by subtracting the equilibrium real exchange rate from the actual real exchange rate.

$$Misalignment = RER_t - ERER_{t-1} \quad (20)$$

Where misalignment is the real exchange rate misalignment, *RER* is the actual real exchange rate, and *ERER* is the equilibrium real exchange rate. Positive results imply real exchange rate undervaluation while negative results imply real exchange rate overvaluation.

2.3.2.1. Real Exchange Rate Misalignment and Economic Performance

After obtaining the RER misalignment indicator, the impact of misaligned RER on economic performance was assessed. Studies such as Ndlela (2012); Tsen Wong (2013); Naseem and Hamizah (2013) also applied the same technique. However, these previous studies did not specify the type of model used, while this study employed the Cobb Douglas function to test the effect of real exchange rate misalignment on economic performance.

The equations are expressed with the variables affecting economic performance drawn from the Cobb Douglas Function for both time periods (1995 to 2016) and (1990 to 2016). The model is specified as follows:

Cobb-Douglas Function with two factors, capital (K) and labour (L)

$$Y_t = A_t K_t^\alpha L_t^\beta \quad (21)$$

L_t denotes the labour input, K_t is the capital input, A is total factor productivity and Y is the gross domestic product

Model 1:

$$Y = \alpha_0 + \alpha_1 K_{i,t} + \alpha_2 L_{i,t} + \alpha_3 MISA_{i,t} + \varepsilon_{i,t} \quad (22)$$

Y denotes the gross domestic product (GDP); a measure of economic performance, K is capital input proxied by gross capital formation; Labour is denoted by total labour force, $MISA$ denotes real exchange rate misalignment and ε is the error term.

Capital influences the gross domestic product positively; the more capital invested the higher the gross domestic product. There is a positive relationship between labour and economic growth as this implies greater productivity therefore a higher gross domestic

product. Real exchange rate misalignment impacts negatively on economic growth; an increase in misalignment leads to a reduction in economic growth.

Model 2:

$$Y = \alpha_0 + \alpha_1 K_{i,t} + \alpha_2 L_{i,t} + \alpha_3 TOT_{i,t} + \alpha_4 MISA_{i,t} + \varepsilon_{i,t} \quad (23)$$

Y represents the gross domestic product (GDP); a measure of economic performance, K is capital input proxied by gross capital formation, Labour is represented by total labour force, TOT represents terms of trade, MISA represents real exchange rate misalignment and ε is the error term.

There is a positive relationship between capital and the gross domestic product; labour and economic growth; terms of trade and economic growth. A percentage increase in any of these variables results in higher economic growth. Whilst real exchange rate misalignment impacts negatively on economic growth; an increase in misalignment leads to a reduction in economic growth.

2.4 Data Description

The study employed two models and two sample periods with annual data, 1995 to 2016 and 1990 to 2016 due to data constraints for some of the variables employed in the models. The African countries are Algeria, Cameroon, Central African Republic, Equatorial Guinea, Gabon, Gambia, Ghana, Lesotho, Morocco, Nigeria, South Africa, Sierra Leone, Togo, Tunisia, Uganda and Zambia and they were selected based on data availability. Data was sourced from Quantec which gives access to organised and updated economic data. Quantec is a consultancy providing economic and financial data, country intelligence and quantitative analytical software with data from sources such as the International Monetary Fund, the World Bank and Central Banks of individual countries. The variables are transformed into logarithms to reduce their variability.

2.4.1. Estimation Technique

Panel estimation techniques were used because of its advantages over cross-sectional and time series data for a large data set. It can control heterogeneity among individual

countries, minimise collinearity and allows for more degrees of freedom thus eliminating any biasness from aggregation.

To capture long-run effects of variables with homogeneous coefficients, the pooled mean group estimator (PMG) is applied. Traditional models such as ordinary least squares, fixed effects, random effects fail to capture this relationship well, hence the PMG estimator. Asteriou and Hall (2007) asserts the appropriateness of the PMG as means of avoiding spurious regressions resulting from the trends and unit roots of present in most macroeconomic data.

The pooled mean group estimator (PMG) accounts for both pooling and averaging. Intercepts, short-run coefficients, and error variances fluctuate across groups and maintain the long-run coefficients (Pesaran, Shin and Smith, 1999). This technique produces consistent and asymptotically normal estimates of the long-run coefficients regardless of the order of integration of underlying regressors, that is, whether $I(1)$ or $I(0)$ (Pesaran, Shin and Smith, 1999). It is also advantageous because it permits heterogeneous short-run dynamics per cross section and they are country specific (Iheonu, Ihedimma and Omenihu, 2017).

The study also employed the Kao test to test for cointegration to determine the presence of a long-run relationship between the equilibrium real exchange rate and the fundamentals. Furthermore, the Dynamic Ordinary Least Squares estimator (DOLS) proposed by Stock and Watson (1993) was applied.

2.4.2. Panel Unit Root Tests

The data was first subjected to the unit root test to test for the stationarity of the data. There are numerous panel unit root techniques available for such an assessment. The study employed the Levin, Lin and Chu Test (LLC Test) and the Im, Pesaran and Shin test.

2.4.3. Levin, Lin and Chu Test (LLC Test)

The LLC test was developed due to the power restrictions of singular unit root tests against alternative hypotheses containing continual shifts from equilibrium. This was more

evident in small samples thus the creation of the LLC which proposed an improved panel unit root test which did not test individual unit root tests per cross-section. The null hypothesis is that each individual time series contains a unit root and the alternative hypothesis is each time series is stationary (Baltagi, 2008). The hypothesis is presented as follows:

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{L=1}^{\rho} \theta_{iL} \Delta y_{i,t-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad m=1,2,3 \quad (24)$$

The LLC test proceeds in the following manner:

Step 1: Performance of individual augmented Dickey-Fuller (ADF) regressions per cross-section:

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{L=1}^{\rho} \theta_{iL} \Delta y_{i,t-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad m=1,2,3 \quad (25)$$

The lag order p_i is permitted to vary across individuals.

Step 2: Estimation of the ratio of long-run to short-run standard deviations under the null hypothesis:

$$\hat{\sigma}_{yi}^2 = \frac{1}{T-1} \sum_{t=2}^t \Delta y_{it}^2 + 2 \sum_{L=1}^{\tilde{K}} \omega_{\tilde{K}L} \left| \frac{1}{T-1} \sum_{t=2+L}^T \Delta y_{it} \Delta y_{i,t-L} \right| \quad (26)$$

Where \tilde{K} is a truncation lag that can be data dependent.

Step 3: Computation of the panel test statistics and running of the pooled regression:

$$\tilde{e}_{it} = \rho \tilde{v}_{i,t-1} + \tilde{\varepsilon}_{it} \quad (27)$$

Based on $N\tilde{T}$ observations where $\tilde{T} = T - \bar{p} - 1$. \tilde{T} represents the number of observations per individual in the panel with $\bar{p} = \sum_{i=1}^N p_i / N$. \bar{p} is the average lag order of individual ADF regressions (Baltagi, 2008).

2.4.4. Im, Pearson and Shin Test (IPS)

The Im, Pearson and Shin Test (IPS) improved on the LLC test because it permitted a heterogeneous coefficient of y_{it-1} and suggested a different testing technique centred on averaging individual unit root test statistics. It differs from the LLC which requires ρ to be homogeneous across i .

IPS proposed that an average of the ADF tests when u_{it} is serially correlated with different serial correlation properties across cross-sectional units. The null hypothesis is that each series in the panel contains a unit root, i.e. $H_0 : \rho_i = 0$ for all i and the alternative hypothesis permits some of the individual series to have unit roots (Baltagi, 2008).

$$H_1 : \begin{cases} \rho_i < 0 & \text{for } i = 1, 2, \dots, N_1 \\ \rho_i = 0 & \text{for } i = N_1 + 1, \dots, N \end{cases} \quad (28)$$

2.4.5. Test for Cointegration

After determining the stationarity of the variables, Kao's (1999) cointegration test was undertaken to determine the presence of a long-run equilibrium relationship among the variables. This method was chosen because it accounts for spurious regression of panel data and employs two types of panel cointegration tests. It makes use of the Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) tests. Moreover, the sequential limit theory of Phillips and Moon (1999) which argued for sequential limits being essential in obtaining asymptotic distributions is used.

2.4.5.1. Kao Test for Cointegration

Kao (1999) presented DF and ADF type tests for cointegration in panel data. For a model

$$Y_{it} = a_i + \beta X_{it} + \hat{u}_{it} \quad (29)$$

The residual based cointegration is used in the equation $\hat{u}_{it} = e\hat{u}_{it-1} + v_{it}$. (30)

Under the Kao test, the following ADF test regression is run:

$$u_{i,t} = \rho u_{i,t-1} + \sum_{j=1}^n \phi_j \Delta u_{i,t-j} + v_{it} \quad (31)$$

The ADF statistic of the null hypothesis of no cointegration is expressed calculated by the following formula:

$$ADF = \frac{t_{ADF} + \sqrt{6N\hat{\sigma}_v} / (2\hat{\sigma}_{0v})}{\sqrt{\hat{\sigma}_{0v}^2 / (2\hat{\sigma}_{0v}^2) + 3\hat{\sigma}_v^2 / (10\hat{\sigma}_{0v}^2)}} \quad (32)$$

The ADF test statistic is represented by t_{ADF} and it is found in the equation above (Asteriou and Hall, 2016).

Once cointegration amongst variables was established, the dynamic OLS approach was employed to estimate the long-run RER model. The dynamic OLS (DOLS) was used based on its performance on bias reduction in finite sample, homogenous and heterogeneous (Kao and Chiang, 2000).

2.4.6. The Dynamic OLS approach

The Dynamic OLS approach developed by Stock and Watson (1993) considers past, present and future values of the change in X_t :

$$C_t = B'X_t + \sum_{j=-J}^{j=J} \eta_j \Delta P_{t-j} + \sum_{j=-K}^{j=K} \lambda_j \Delta Y_{t-j} + \zeta_t \quad (33)$$

Fundamentally, the DOLS procedure regresses I(1) variables on other I(1) variables, I(0) variables and leads and lags of the first differences of I(1) variables (Masih and Masih, 1996). This method takes into consideration efficient estimators of co-integrating vectors including deterministic components. In addition, different orders of integration and potential concurrence between variables is considered. Leads and lags of different variables in the equation containing a co-integrating vector eradicates the bias of concurrence and the small sample bias (Irffi, Castelar, Siqueira and Linhares, 2008).

2.5. Estimation Results

This section presents the empirical results of the stationarity test, estimation of the real exchange rate cointegration, long-run coefficient, Dynamic OLS Estimates (DOLS) and real exchange rate misalignment and macroeconomic performance estimation.

2.5.1. Stationarity Tests

The variables were subjected to the LLC and the IPS stationarity tests. The results are presented in Tables 1 and 2:

Table1: Unit Root Test - Model 1 (1995 to 2016)

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-1.42897 (0.0765)	-0.63679 (0.2621)	-0.49669 (0.3097)	-0.58972 (0.2777)
LINFL	-11.8844 (0.0000)*	-10.7254 (0.0000)*	-12.4162 (0.0000)*	-11.0833 (0.0000)*
LGOVEXP	-0.64036 (0.2610)	-4.03337 (0.0000)*	-0.57794 (0.2817)	-2.51781 (0.0059)*
LTARIFFS	-0.98765 (0.1617)	2.41675 (0.9922)	2.72052 (0.9967)	1.52334 (0.9362)
LINV	-11.8844 (0.0000)*	-10.7254 (0.0000)*	-12.4162 (0.0000)*	-11.0833 (0.0000)*
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-13.4907 (0.0000)*	-10.3966 (0.0000)*	-11.1666 (0.0000)*	-7.95154 (0.0000)*
LINFL	-20.0685 (0.0000)*	-16.7294 (0.0000)*	-22.0215 (0.0000)*	-19.1432 (0.0000)*

LGOVEXP	-11.3570 (0.0000)*	-9.06609 (0.0000)*	-12.7766 (0.0000)*	-10.3254 (0.0000)*
LTARIFFS	-12.7728 (0.0000)*	-9.18791 (0.0000)*	-11.3018 (0.0000)*	-8.03328 (0.0000)*
LINV	-20.0685 (0.0000)*	-16.7294 (0.0000)*	-22.0215 (0.0000)*	-19.1432 (0.0000)*

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Table 2: Unit Root Test - Model 2 (1990 to 2016)

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-3.54621 (0.0002)*	-4.32355 (0.0000)*	-3.47528 (0.0003)*	-3.87624 (0.0001)*
LGOVEXP	-5.51397 (0.0000)*	-4.18105 (0.0000)*	-2.83844 (0.0023)*	-2.07515 (0.0190)*
LFDI	-3.35397 (0.0004)*	-3.96965 (0.0000)*	-2.62995 (0.0043)*	-7.39800 (0.0000)*
LINFL	-6.92330 (0.0000)*	2.47077 (0.9933)	-1.02864 (0.1518)	-1.18551 (0.1179)
LTOT	-1.25129 (0.1054)	-0.06803 (0.6316)	-0.38659 (0.3495)	-1.25918 (0.1040)
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-18.5659 (0.0000)*	-16.4115 (0.0000)*	-17.1066 (0.0000)*	-14.8175 (0.0000)*
LGOVEXP	-11.6682 (0.0000)*	-9.76634 (0.0000)*	-12.9793 (0.0000)*	-11.4472 (0.0000)*

LFDI	-19.4604 (0.0000)*	-15.4665 (0.0000)*	-22.2376 (0.0000)*	-20.0447 (0.0000)
LINFL	-9.19896 (0.0000)*	-6.26249 (0.0000)*	-8.80218 (0.0000)*	-7.87933 (0.0000)*
LTOT	-15.0798 (0.0000)*	-12.2396 (0.0000)*	-15.0580 (0.0000)*	-12.6015 (0.0000)*

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Tables 1 and 2 display the LLC and the IPS panel unit root test results at levels and first difference for models 1 and 2.

The LLC and IPS test unit root tests coincide and they reveal that in model 1, variables LINFL, LGOVEXP and LINV are stationary at levels, they are integrated of order zero I(0). While LRER and LTARIFFS become stationary at first difference, therefore they are integrated of order one I(1).

In model 2, all variables except (LTOT) are stationary at levels, they are integrated of order zero I(0). LTOT becomes stationary at first difference, therefore it is integrated of order one I(1).

2.5.2. Estimation of the Real Exchange Rate Cointegration Results

Table 3 reports the results of Kao’s residual panel cointegration tests, which rejected the null hypothesis of no cointegration because the p value is less than 5%, therefore, there is a cointegration relationship amongst the variables.

Table 3: Kao Cointegration Test Results for Model 1 and Model 2

Model 1	t-statistic	Probability
ADF	-2.556528	0.0053*
Model 2	t-statistic	Probability
ADF	-3.585961	0.0002*

NB: The ADF is the residual-based ADF statistic. The null hypothesis is no cointegration. * Indicates that the estimated parameters are significant at the 5% level

The conclusion therefore, is that there is a panel long-run equilibrium relationship among the real exchange rate, terms of trade, inflation, import tariffs and government expenditure in the long-run.

2.5.3. Long-run coefficient - Dynamic OLS Estimates (DOLS)

The results exhibit the presence of a cointegration relationship amongst the variables therefore the dynamic OLS approach is employed to estimate the long-run RER model and the results are presented in Table 4.

Table 4: DOLS long-run estimation results. Dependent variable: LRER

Sample Period	1995-2016	1990-2016
Explanatory Variables	Model 1 Coefficients	Model 2 coefficients
LINFL	-0.040711 (0.2051)	-0.140248 (0.0665)*
LGOVEXP	-0.153702 (0.0013)**	-0.013619 (0.7523)
LTARIFFS	0.219374 (0.0001)**	-
LINV	-0.283052 (0.0002)**	-
LFDI	-	-0.023019 (0.3110)
LTOT	-	0.149011 (0.0110)**
R-squared	0.773453	0.811598
S.E. of regression	0.161295	0.150437

*p-values are in parentheses ()

*10 % statistically significant.

**5 % statistically significant.

***1 % statistically significant.

Table 4 presents the long-run coefficients results of the DOLS estimator. The results reveal that inflation is statistically significant and consistent with economic theory in model 2. Inflation complies with theory in model 1, however, the coefficient is not statistically

significant. Government expenditure is statistically significant in model 1, while investment as a share of GDP, tariffs and terms of trade from model 1 are consistent with economic theory and are statistically significant.

A 1% increase in inflation would depreciate the real exchange rate by 0.14% thereby indicating a negative relationship between the two variables as stipulated by economic theory. 1% increase in government expenditure would depreciate the real exchange rate by 0.15% while a 1% increase in tariffs would lead to an appreciation of the real exchange rate by 0.21%. The relationship between terms of trade and the real exchange rate is positive and statistically significant. 1% increase in the terms of trade appreciates the real exchange rate by 0.14%.

Each of the models have an R^2 greater than 70%. This implies that the models are generally a good fit as more than 70% of the variations of the dependent variable is explained by the independent variables.

After establishing the long-run relationship amongst the fundamentals, real exchange rate misalignment was computed.

2.5.4. Computed Real Exchange Rate Misalignment

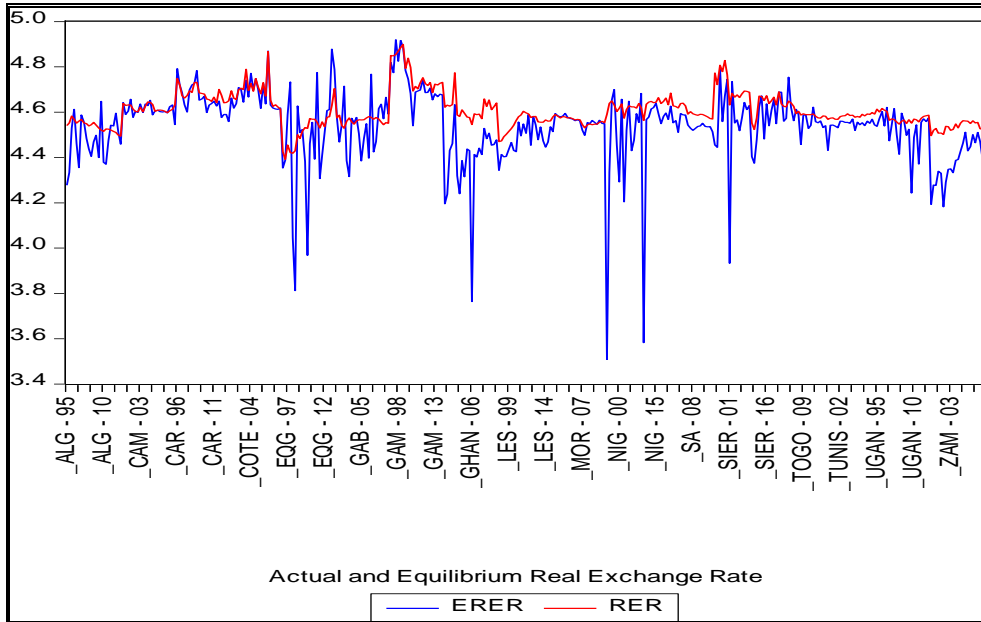


Figure 1: Actual and Equilibrium Real Exchange Rate (Model 1: 1995-2016)

*ERER is the equilibrium real exchange rate and RER is the actual real exchange rate

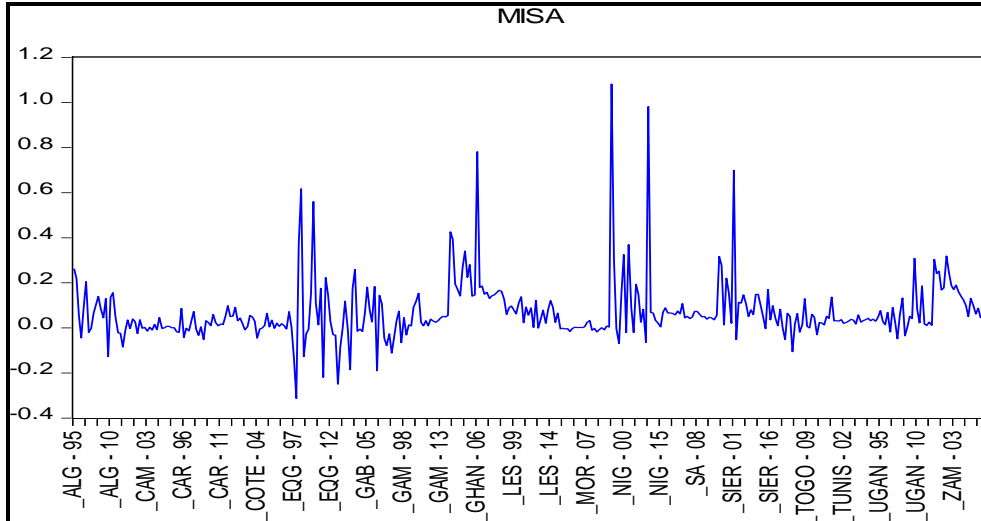


Figure 2 Real Exchange Rate Misalignment - Model 1(1995-2016)

*MISA denotes real exchange rate misalignment

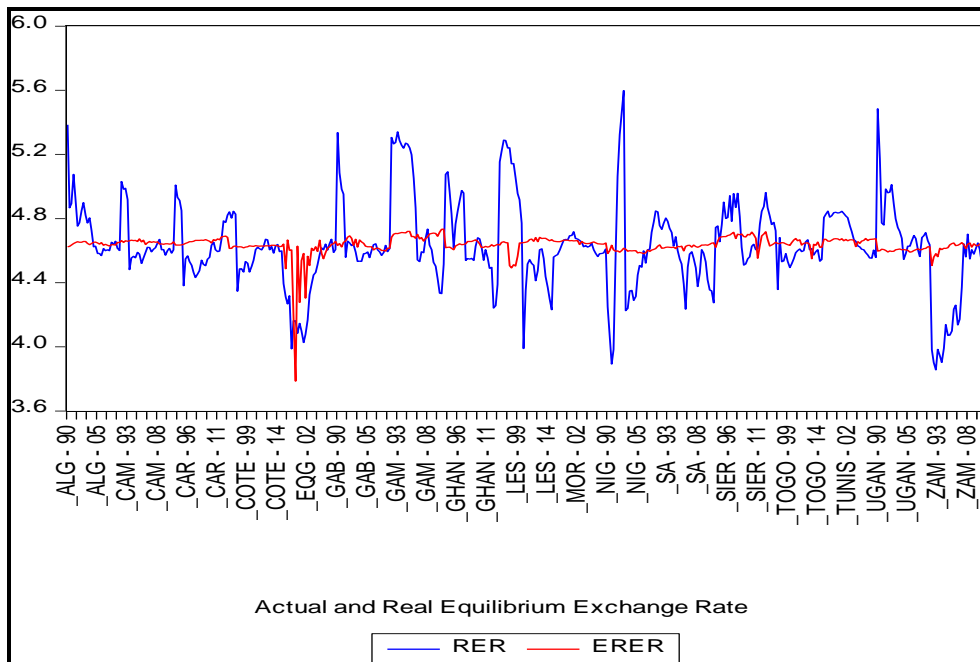


Figure 3: Actual and Real Exchange Rate (Model 2: 1990-2016)

*ERER is the equilibrium real exchange rate and RER is the actual real exchange rate

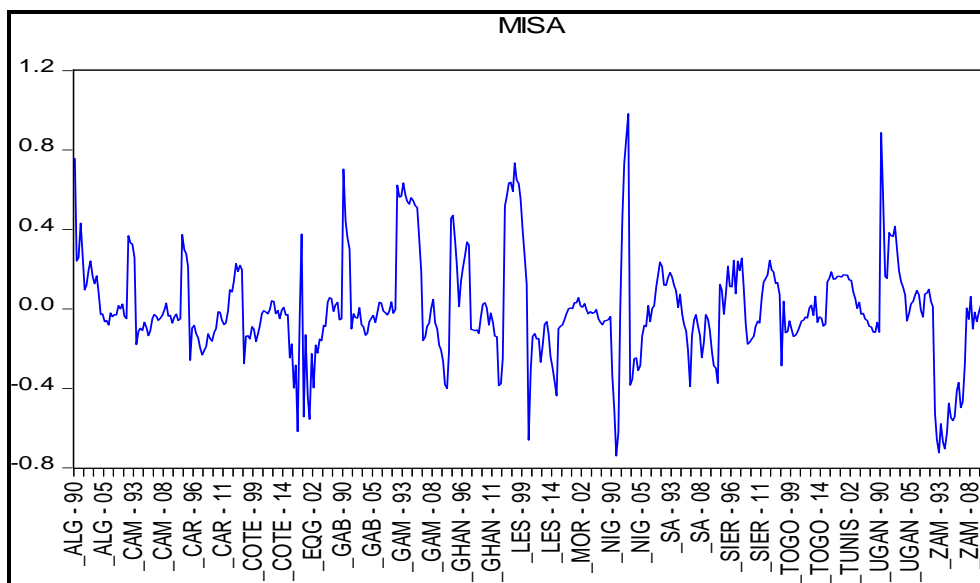


Figure 4 Real Exchange Rate Misalignment - Model 2 (1990-2016)

*MISA denotes real exchange rate misalignment

Figures 1, 2, 3 and 4 display the RER misalignment levels for models 1 and 2, time periods 1990 to 2016 and 1995 to 2016. Overall, there were more periods of overvaluation than undervaluation. These results are similar to Ali *et.al* (2015) who found more periods

of overvaluation than undervaluation in Nigeria. They attributed these findings to the possible exchange rate policies that halted undervaluation episodes during the estimation period.

2.6. Real Exchange Rate Misalignment and Macroeconomic Performance

2.6.1. Test for Stationarity

The table presents results of the unit roots test conducted on the model specified in section 2.3.2.1. The variables were subjected to the LLC and the IPS stationarity tests. The results are presented in Tables 5 and 6 below:

Table 5: Unit Root Test - Model 1 (1995 to 2016)

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LGDP	-0.55879 (0.2882)	0.66099 (0.74570)	4.09194 (1.0000)	2.00461 (0.9775)
LCAP	-11.8844 (0.0000)*	-10.7254 (0.0000)*	-12.4162 (0.0000)*	-11.0833 (0.0000)*
LLAB	-2.23151 (0.0128)*	-3.26076 (0.0006)*	3.49022 (0.9998)	-0.56796 (0.2850)
MISA	-5.58002 (0.0000)*	-4.52281 (0.0000)*	-7.76501 (0.0000)*	-6.60874 (0.0000)*
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
	LGDP	-4.94848 (0.0000)*	-7.83556 (0.0000)*	-5.28434 (0.0000)*
LCAP	-20.0685 (0.0000)*	-16.7294 (0.0000)*	-22.0215 (0.0000)*	-19.1432 (0.0000)*

LLAB	-3.26425 (0.0005)*	-0.08344 (0.4668)	-2.70014 (0.0035)*	1.43395 (0.9242)
MISA	-15.9539 (0.0000)*	-13.0606 (0.0000)*	-17.7796 (0.0000)*	-15.1994 (0.0000)*

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Table 6: Unit Root Test - Model 2 (1990 to 2016)

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LGDP	0.24447 (0.5966)	-0.55213 (0.2904)	5.79912 (1.0000)	-0.03212 (0.4872)
LCAP	-1.09888 (0.1359)*	-0.80533 (0.2103)*	-1.01012 (0.1562)*	-1.47663 (0.0699)*
LLAB	0.84785 (0.8017)*	-6.49238 (0.0000)*	3.57978 (0.9998)	-2.23595 (0.0127)
LTOT	-1.25129 (0.1054)	-0.06803 (0.6316)	-0.38659 (0.3495)	-1.25918 (0.1040)
MISA	-1.70119 (0.0445)*	-2.17400 (0.0149)*	-2.65832 (0.0039)*	-2.71383 (0.0033)*
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LGDP	-6.43737 (0.0000)*	-5.68072 (0.0000)*	-6.59037 (0.0000)*	-4.27152 (0.0000)*
LCAP	-10.5465 (0.0000)*	-8.36146 (0.0000)*	-13.1706 (0.0000)*	-11.0200 (0.0000)*
LLAB	-2.00272 (0.0226)*	2.01594 (0.9781)	-1.29763 (0.0972)*	1.02507 (0.8473)
LTOT	-15.0798 (0.0000)*	-12.2396 (0.0000)*	-15.0580 (0.0000)*	-12.6015 (0.0000)*

MISA	-12.4163 (0.0000)*	-11.0808 (0.0000)*	-12.3524 (0.0000)*	-10.6043 (0.0000)*
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*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Tables 5 and 6 depict the LLC and the IPS panel unit root test results at levels and first difference for models 1 and 2. For model 1 first difference, all variables (LGDP, LLAB, LCAP and MISAL are I(1) both at the constant trend of the panel unit root regression, while LGDP is I(0). These results therefore call for the rejection of the null hypothesis of a panel unit root.

2.6.2. Real Exchange Rate Misalignment and Macroeconomic Performance Cointegration Results

Table 7 reports the results of Kao's residual panel cointegration tests, which reject the null hypothesis of no cointegration because the p value is less than 5%, therefore there is a cointegration relationship amongst the variables.

Table 7: Kao Cointegration Test Results for Model 1 and Model 2

Model 1	t-statistic	Probability
ADF	-3.452817	0.0003*
Model 2	t-statistic	Probability
ADF	-5.493989	0.0000*

NB: The ADF is the residual-based ADF statistic. The null hypothesis is no cointegration. * Indicates that the estimated parameters are significant at the 5% level

The conclusion therefore, is that there is a panel long-run equilibrium relationship among the gross domestic product, capital, labour and misalignment in the long-run.

2.7. Pooled Mean Group (PMG) Estimates

Table 8: PMG Results – Model 1

Dependent Variable: GDP

Long-run Coefficients	
CAP	0.285056 (0.0012)*
LAB	1.890046 (0.0000)*
MISA	-2.439693 (0.0001)*
Short-run Coefficients	
ΔCAP	0.038257 (0.0514*)
ΔLAB	-3.134675 (0.1714)
ΔMISA	-0.017637 (0.7028)
Constant	0.033032 (0.7825)
Error Correction Coefficient	-0.069643 (0.0017)*

Table 9: PMG Results – Model 2**Dependent Variable:** GDP

Long-run Coefficients	
CAP	-0.022233 (0.5395)
LAB	1.148974 (0.0000)*
TOT	0.963529 (0.0000)
MISA	0.096344 (0.1115)
Short-run Coefficients	
ΔCAP	0.059628 (0.0031)*
ΔLAB	-4.575919 (0.0862)
ΔTOT	-0.014487 (0.6086)
ΔMISA	0.004427 (0.8276)
Constant	0.033032 (0.7825)
Error Correction Coefficient	-0.073185 (0.0357)*

Table 8 displays the PMG estimation results for model 1, period 1995 to 2016. In the long-run, capital and labour influence growth positively. A one percent growth in capital leads to 0.29 percent increase in growth. This positive influence of capital also resonates in the short-run. One percent growth in labour leads to 1.9 percent increase in growth.

Like Abida (2011), model 1 experienced an undervalued currency which is a condition that encourages growth in an economy. A depreciated real exchange rate encourages economic growth. While an appreciated real exchange rate is not favourable as it tends to harm long-run growth; these results are like those of Vieira and MacDonald (2012). The RER misalignment coefficient for model 2 is positive implying an overvaluation which promotes economic growth.

2.8. Conclusion

The study aimed to estimate the equilibrium real exchange rate, construct measures of real exchange rate misalignment and test the effects of real exchange rate misalignment on economic performance for a selection of African countries. Two models with different time periods were estimated, from 1995 to 2016 and 1990 to 2016. The real exchange rate model and the real exchange rate misalignment and macroeconomic performance model were also estimated.

Cointegration tests were undertaken to determine the presence of a long-run equilibrium relationship among the variables. Upon establishing cointegration amongst the different variables, long-run RER model was performed using the DOLS. RER misalignment results revealed more periods of overvaluation than undervaluation for models 1 and 2, time periods 1995 to 2016 and 1990 to 2016. The findings of the study are similar to the study on Nigeria by Ali *et.al* (2015) who found more periods of overvaluation than undervaluation which were attributed to the possibility of exchange rate policies halting undervaluation episodes during the estimation period. According to literature, overvaluation of the real exchange rate affects economic growth negatively, especially for developing countries. It may result in a tightened monetary policy thereby leading to a recession, discrimination against exports and capital flight amongst other economic issues.

Based on the results, the study advocates for the selected countries, most of which are classified as developing countries to adopt economic policies that promote competitive real exchange rates; and avoid sustained real exchange rate appreciation where the actual real exchange rate (RER) differs significantly from its long-run equilibrium value.

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Chapter Three

Productivity and Growth: Investigating the Validity of the Balassa-Samuelson Effect in a Selection of Five African Countries

Abstract

Productivity in any economy is important because it increases economic performance and promotes economic growth. Given the importance of productivity, the study investigated the validity of the Balassa-Samuelson Effect in five African countries. The focal point of the Balassa-Samuelson (BS) effect is the relationship between productivity growth and real exchange rate appreciation. The study estimated the equilibrium real exchange with total factor productivity as an explanatory variable. Further, real exchange rate misalignment was derived and its effects on economic performance tested. The study employed more than one measure of economic performance in assessing the effects of real exchange rate misalignment on economic performance. The results revealed a valid Balassa-Samuelson effect in the selected countries and negative coefficients for real exchange rate misalignment. Recommendations emanating from this study include countries pursuing policies that contain misalignment of the real exchange rate because sustained misalignment hampers economic growth, performance and competitiveness.

Keywords: Real Exchange Rate, Real Exchange Rate Misalignment, Balassa-Samuelson

3.1. Introduction

The Balassa-Samuelson hypothesis is a result of an augmentation of the Purchasing Power Parity (PPP). Balassa (1964) questioned the validity of the PPP as a theory that explained the determination of the equilibrium exchange rate (Moosa, 2012). Balassa and Samuelson argued that labour productivity differentials between tradable and non-tradable sectors translate to fluctuations in real costs and relative prices and lead to divergences in the exchange rate adjusted national prices (Asea and Mendoza, 1994). A country with more relative productivity advantage in tradables than in relative productivity advantage in non-tradables ought to possess a higher real exchange rate (Mercereau, 2003). Moreover, the hypothesis describes real exchange rate volatility using the differential productivity of the tradable and non-tradable sectors (Romanov, 2003).

The Balassa-Samuelson hypothesis relies on the differential productivity levels between a country and its trading partners; it also assumes that productivity growth is biased as it favours the traded goods sector. Countries with higher productivity levels than its trading partners are inclined to have greater productivity differentials in traded goods sectors than non-traded goods sectors. Higher productivity in traded goods permits the sector to move labour from the non-traded goods sector thereby increasing costs in the non-traded goods sector. In turn, this requires a higher relative price of non-traded goods to maintain profitability in the sector (Montiel, 2007).

The hypothesis emerged because of the difference of productivity growth among sectors and wages that are generally less differentiated. Normally, productivity grows rapidly in the traded goods sector than in the non-traded goods sector. Rapid productivity growth in the traded goods sector raises wages in all sectors; the prices of non-traded goods relative to the prices of traded goods increase resulting in the growth of the overall price index. Moreover, the speed of productivity is faster in developing countries in an attempt to catch up with developed countries (Kharas, 2010).

The Balassa-Samuelson model employs the decomposition of the price level into traded and nontraded prices. Hence, the real exchange combines the real exchange rate for traded goods and the ratio of the relative prices of traded to nontraded goods in two

economies. Higher productivity growth in the tradable sector in one country implies that the relative non-tradables to tradables prices will increase more rapidly (Driver, Sinclair and Thoenissen, 2013).

The tradable goods sector constitutes the manufacturing and agriculture while the non-tradable goods sector constitutes of services. In level form, the Balassa effect forecasts that countries with relatively lower productivity in tradable goods than in non-tradable goods, which is the norm in emerging or developing countries; have lower price levels than in other countries (Coudert, 2004). Higher productivity in the tradable sector of wealthy countries leads to an increment in the general level of prices and the real exchange rates; while low productivity in the tradable sector of poor countries is normally inclined to maintain or reduce the general level of prices and more devaluated/depreciated exchange rates under the Balassa-Samuelson effect (Martinez-Hernandez, 2017). In terms of development, the Balassa effect describes the appreciation movement of the real exchange rate in countries going through a process of economic catching-up, following the relative productivity profits in the tradable goods sector (Coudert, 2004).

Under the hypothesis, higher profitability in the tradable division of rich nations raises the general level of costs and the genuine trade rates; while low efficiency in the tradable area of poor nations is normally maintained or reduced to the general level of costs and more devaluated/deteriorated trade rates (Martinez-Hernandez, 2017).

Several studies in literature have tested the validity of the Balassa-Samuelson hypothesis for both developed and developing countries (Drine and Rault (2002); Gubler and Sax (2011)). Other studies further explored incidences of real exchange rate misalignment (Kakkar and Yan (2012)) and other studies examined the influence of real exchange rate misalignment on economic performance (Sallenave (2010); Vieira and MacDonald (2012)). Previous studies investigated the Balassa-Samuelson effect in different contexts with the following gap identified. Other studies use proxy variables for total factor productivity whereas this study computes total factor productivity by using the Cobb-Douglas production function. According to Tintin (2009) total factor productivity (TFP) is

a better representation of productivity. Like previous studies, this study attempts to test the validity of the Balassa-Samuelson hypothesis for a selection of African countries.

The study is organised as follows. Section 3.2 presents the literature review. Sections 3.3 and 3.4 present the methodology and the empirical models estimated. Sections 3.5 to 3.7 present and explain the empirical results, while the conclusion and recommendations are presented in Section 3.8.

3.2. Literature Review

This section presents the theoretical foundations and empirical literature related to the Balassa-Samuelson Effect. The empirical literature includes studies from developing and developed countries.

3.2.1. The Balassa-Samuelson Model

The Balassa-Samuelson model hypothesises that higher productivity differentials in production of tradable goods between countries cause great differences in wages and in the prices of services as well as pronounced differences between the purchasing power parity and equilibrium exchange rate. The Balassa-Samuelson model is based on productivity differentials influencing the domestic relative price of non-tradables while divergences from PPP display disparities in the relative price of non-tradables (Asea and Corden, 1994).

Asea and Corden (1994) provided an overview of the Balassa-Samuelson model:

The Balassa-Samuelson model is comprises a small open economy consisting of capital and labour to produce tradable goods (T) priced world markets and non-tradables (NT) priced in the domestic market. Perfect mobility is presumed for capital and labour across all domestic sectors while labour is presumed to be immobile between countries and capital is not restricted internationally.

Another assumption is that of full employment in the economy.

$$L = L_T + L_N \tag{1}$$

Where the labour in the tradable sector is represented by L_T and L_N is labour in the non-tradables sectors. To produce tradables and not tradables, inputs of capital (K_T, K_N) and labour (L_T, L_N) are necessary. Linear homogenous functions describe technology in each sector:

$$Y_T = \theta_T K_T^{\beta_T} L_T^{\alpha_T} \equiv \theta_T L_T f(k_T) \quad \text{and} \quad Y_N = \theta_N K_N^{\beta_N} L_N^{\alpha_N} \equiv \theta_N L_N f(k_N) \quad (2)$$

Where Y_T, Y_N represent the output in the tradable and non-tradable sectors while $k_T \equiv K_T / L_T$ and $k_N \equiv K_N / L_N$ and θ_T, θ_N are stochastic productivity parameters.

The world interest rate i is used as given. The presence of perfect competition equates the world interest rate to the value of the marginal product of capital in each sector:

$$i = \theta_T \beta_T k_T^{(\beta_T-1)} \quad \text{and} \quad i = s \theta_N \beta_N k_N^{(\beta_N-1)} \quad (3)$$

Where $s = P^N / P^T$ is the relative price of non-tradables (the real exchange rate).

$i = \theta_T \beta_T k_T^{(\beta_T-1)}$ determines capital-labour in tradables (k_T). The two factors of production are utilised to obtain the factor price frontier by maximising profit ($F(K, L) - wL - rk$) which in turn creates factor demand function in each sector. The notion of linear homogeneity allows the wage rate in the tradable sector to be represented by:

$$\begin{aligned} w &= \theta_T [f(k_T) - f'(k_T)k_T] \\ &= \theta_T (1 - \beta_T) k_T^{\beta_T} \end{aligned} \quad (4)$$

Where $f''(k) < 0$ is an increasing function of k meaning that $i = f'(k)$ is a decreasing function of k . w and i therefore decrease to the factor price frontier, a downward locus on the (w, i) plane with parameter k . Solving for k_T from $(i = s \theta_N \beta_N k_N^{(\beta_N-1)})$ and substituting in $(w = \theta_T (1 - \beta_T) (\theta_T \beta_T / i)^{\frac{\beta_T}{1-\beta_T}})$ yields the wage equation:

$$w = (1 - \beta_T)(\theta_T \beta_T / i)^{\frac{\beta_T}{1-\beta_T}} \quad (5)$$

In a small economy, the determination of the wage (w) is reliant on factor productivity in tradables.

Where: the capital-labour ratio as derived from $i = s\theta_N \beta_N k_N^{(\beta_N-1)}$ results in:

$$k_N = (s\theta_N \beta_N / i)^{\frac{1}{1-\beta_N}} \quad (6)$$

For perfect competition in the non-tradables sector, the following condition should hold:

$$s = \theta_N f(k_N) = ik_N + w \quad (7)$$

From $(Y_N = \theta_N K_N^{\beta_N} L_N^{\alpha_N} \equiv \theta_N L_N f(k_N))$, $w = \theta_T (1 - \beta_T)(\theta_T \beta_T / i)^{\frac{\beta_T}{1-\beta_T}}$ and $k_N = (s\theta_N \beta_N / i)^{\frac{1}{1-\beta_N}}$ for given \hat{z} the relative price of nontradables is:

$$\hat{s} = \alpha_N \hat{w} - \hat{\theta}_N \quad (8)$$

$$s = \frac{\alpha_N}{\alpha_T} \hat{\theta}_T - \hat{\theta}_N \quad (9)$$

Where a hat signals the rate of percentage change and the relative price of non-tradables is dependent on the productivity differential in the tradable and non-tradables sectors.

Although the Balassa-Samuelson theory is employed to decipher economic issues by economists and policymakers, it is not without weaknesses. Bergin et al (2004) cited that productivity gains were not only limited to manufactured goods but included gains from information technology and retail as assumed by the theory. The theory also overlooks services such as information services becoming increasingly tradable due to technological advancements. Genius and Tzouvelekas (2008) remonstrated the neglect of time-specific factors that potentially influenced the relationship between productivity and real exchange rates. They further mentioned that the assumption of unobservable country-specific factors impartially influencing the projected connection between labour

productivity and real exchange rates was restrictive. However, the Balassa-Samuelson theory remains a popular choice amongst economists and policymakers to interpret various applied issues.

3.2.2. Empirical Literature

Bahmani-Oskooee and Nasir (2001) estimated a random coefficients model permitting country and time-specific productivity effects. They employed an analytic framework expressing an individual country's productivity and real exchange rates relative to the United States (US). The study was for the period 1965 to 1992 and results revealed an invalid Balassa-Samuelson hypothesis for most African countries and some Latin American countries while it was valid for OECD countries and Asia.

Ito, Isard and Symansky (1999) investigated the Balassa-Samuelson hypothesis in high-growth Asian countries. A generally pronounced Balassa-Samuelson effect was observed in Japan, Korea, and Taiwan. The study further suggested that the validity of Balassa-Samuelson hypothesis to an economy depended on the stage of that economy. The hypothesis is particularly suited for a rapidly expanding under resourced open economy; the expansion must entail a move from an industrial structure and export composition. However, a growing economy does not imply applicability of the Balassa-Samuelson if the economy has recently emerged from the primary goods exporter or planned economy phase.

In an analysis of the long-run determination of exchange rates using sectoral data in twenty-four developing countries and fourteen OECD economies, Giacomelli (1998) found results in support of the Balassa-Samuelson effect. While Faria and León-Ledesma's (2003) revealed results unsupportive of the Balassa-Samuelson effect in the long-run between two countries (the UK and US, Germany and Japan and Japan and the US). Genius and Tzouvelekas (2008) tested for the Balassa-Samuelson hypothesis on fifty-nine industrialised and developing countries (including African countries such as Rwanda and Ivory Coast amongst others). Results of the study revealed that the hypothesis was invalid in most African countries and some Latin American countries. The hypothesis held for OECD countries and Asia.

Egert et al (2002) explored the hypothesis in the Czech Republic, Hungary, Poland, Slovakia and Slovenia using time series and panel cointegration approaches. The results of the study presented a good application of the hypothesis in these transition economies for the period of 1991Q1 to 2001Q2. However, the study found that productivity growth did not entirely lead to price increments because of the construction of the CPI indexes. DeLoach (2001) conducted a study to uncover evidence in support of the Balassa-Samuelson hypothesis. The results revealed a relationship consistent with the Balassa-Samuelson hypothesis, that of a significant long-run relationship between the relative price of non-tradables and real output.

Drine and Rault (2002) conducted an empirical investigation and tested the validity of the Balassa-Samuelson (BS) hypothesis in six Asian countries. A panel data cointegration procedure developed by Pedroni (2000, 2004) was used and further compared to the traditional Johansen cointegration test. A long-run relationship between real exchange rates and productivity differential was observed under the traditional time series model; while advanced dynamic panel techniques showed contrary results. This was attributed to the absence of a positive long-run relationship between productivity differential and relative prices.

Tintin (2009) investigated the Balassa-Samuelson hypothesis in ten OECD countries for the period 1975 and 2007. A country-specific analysis was conducted through the Johansen cointegration techniques and findings suggested that the BS hypothesis was valid in OECD countries. Gubler and Sax (2011) investigated the robustness of the Balassa-Samuelson hypothesis for panel of OECD countries for the period of 1970 to 2008. The real exchange rate was conditioned on the measures of productivity for both the tradable and the non-tradable sector in addition to control variables such as the terms of trade and government spending share. The DOLS model specifications and employ the between-dimension group-mean panel FMOLS estimator from Pedroni (2001) were employed. The study did not find evidence of the Balassa-Samuelsson hypothesis.

Omojimate and Oriavwote (2012) conducted a study to examine the relationship between the Naira real exchange rate and macroeconomic performance and the Balassa-Samuelson hypothesis in Nigeria. The Parsimonious ECM results revealed a negative

sign and a statistically significant one period lag value of technological productivity. These results therefore implied the existence of the Balassa-Samuelson hypothesis in Nigeria. The time series data covered the period 1970 to 2009 and the Johansen Cointegration procedure was employed.

Choudhri and Khan (2005) tested for the Balassa-Samuelson in sixteen developing countries including African countries such as Kenya, Morocco, South Africa and Cameroon. The study showed that traded-nontraded productivity differentials were vital because they impact relative price of nontraded goods, and that the relative price applied a substantial effect on the real exchange rate. Likewise, the terms of trade influence the real exchange rate.

Tica and Družić (2006) investigated the Harrod-Balassa-Samuelson (HBS) effect on fifty-eight empirical papers. The evidence supported the HBS model, these results were influenced by the types of tests applied and set of investigated countries. Funda, Lukinić, Ljubaj (2007) examined the Balassa-Samuelson effect in Croatia for the period 1998 Q1 to 2006 Q3. No evidence of the Balassa-Samuelson effect in Croatia was found.

Macdonald and Ricci (2001) investigated the impact of the distribution sector on the real exchange rate, including the Balassa-Samuelson effect and other macroeconomic variables such interest rates, size of net foreign assets to GDP ratios for ten countries. A panel dynamic OLS estimator was employed to estimate long-run coefficients. Results revealed growth in productivity and competitiveness of the distribution sector that translated to appreciation of the real exchange rate with respect to foreign countries. Chowdhury (2011) found evidence of the Balassa-Samuelson effect in Australia for the period 1990-2003. The ARDL cointegration framework was used.

Égert et al (2002) examined the Balassa-Samuelson effect in nine Central and Eastern European Countries. Panel cointegration methods were employed and evidence of internal transmission mechanism was found. It was attributed to non-tradable inflation in the open sector because of productivity growth. Kakkar and Yan (2012) examined the Balassa-Samuelson effect for six Asian economies and further examined real exchange rate misalignment with findings that most real exchange rates were overvalued.

Sallenave (2010) created a model adjusted for the Balassa-Samuelson effect in a study about the growth effects of real effective exchange rate misalignments for the G20 countries. Similarly, Vieira and MacDonald (2012) studied the impact of real exchange rate misalignment on long-run growth for a set of ninety countries with adjustments for the Balassa-Samuelson effect by using real GDP per capita (LRGDPCH) to account for the Balassa-Samuelson effect. They found that exchange rate misalignment impacted economic growth.

Suleiman and Muhammad (2011) conducted a study estimating the long run effects of real oil price on real exchange rate by means of the Johansen procedure from 1980 to 2010 in Nigeria. The empirical analysis examined the effect of oil price fluctuations and productivity differentials (embodies the Balassa-Samuelson) on the real effective exchange. The result suggested that real oil price had a significant positive effect on the real exchange rate in the long run whilst productivity differentials had a significant negative influence on the real exchange rate. The productivity differentials were expressed against the trading partners of Nigeria. Contrary to Omojimito and Oriavwote's (2012) results, this study found no evidence of the Balassa-Samuelson effect in Nigeria shown by the negative and significant coefficient on the productivity differential. The appreciation of the real exchange rate was credited to improvements in oil prices, not the Balassa Samuelson effect.

3.2.2.1. Limitations of Reviewed Studies and Contribution to Literature

Based on the empirical inconclusiveness established in previous studies, this study investigated the Balassa-Samuelson effect in five African countries. The reviewed studies investigated the Balassa-Samuelson effect in different contexts with the following gaps identified:

- i) Other studies use proxy variables for total factor productivity whereas this study computes productivity by using the Cobb-Douglas production function.
- ii) Only a few studies further investigated real exchange rate misalignment such as Kakkar and Yan (2012).

However, other studies extended their analysis and examined the influence of real exchange rate misalignment on economic performance (Sallenave (2010); Vieira and

MacDonald (2012). The study creates an equilibrium real exchange rate by substituting permanent values of the explanatory variables into an estimated cointegration relationship. The estimated coefficients are imposed on the permanent values of the explanatory variables, the Hodrick Prescott (HP) filter was used to create the permanent values.

Previous studies used only one measure of economic performance; these studies only used the gross domestic product as a measure of economic performance. The gross domestic product indicates the amount of output produced in a country. This study differs by employing the unit labor cost as an additional measure of economic performance. Unit labour costs indicate the economic competitiveness of a country. The unit labour costs (ULC) forms part of the best complementary indicators on an economy. It is regularly applied to evaluate economic development in numerous countries, both individual and grouped. This indicator gives a holistic view of the quality of economic growth by placing into context the overall production output of an economy (GDP), labour productivity, wage and other costs connected with the workforce and price development (Lipská, Vlnková and Macková, 2005). Moreover, the use of multiple measures of economic performance offers improved robust results considered authentic or dependable through triangulation (Kuorikoski, Lehtinen and Marchionni, 2007).

As the Balassa-Samuelson influences the equilibrium level of the real exchange rate, it is imperative to evaluate the equilibrium level to assess real exchange rate misalignment. Misalignment of the real exchange rate generally affects the direction of economic growth, performance and competitiveness.

3.3. Methodology

The tools and techniques employed in testing for the Balassa-Samuelson effect in a panel of African countries are presented in this section. Further, real exchange rate misalignment and the effects of misalignment on economic performance are also presented.

3.3.1. Model Specification

All variables are expressed in logarithms to reduce data variability and the empirical model is expressed as follows.

$$LRER_{i,t} = \alpha_0 + \beta_1 LPROD_{i,t} + \beta_2 LTOT_{i,t} + \beta_3 NFA_{i,t} + \varepsilon_t \quad (10)$$

The study used the weighted average of a country's currency in relation to an index or basket of other major currencies, that is, the real effective exchange rate to represent the real exchange rate (LRER). An increase in RER is appreciation and a decrease is depreciation. (LPROD) represents total factor productivity, an increase in (LPROD) leads to real exchange rate appreciation. LPROD captures the Balassa-Samuelson effect which hypothesises that rapid economic growth is associated with real exchange rate appreciation because of differential productivity growth between tradable and non-tradable sectors.

The productivity, LPROD, is computed by using the Cobb-Douglas production function where: $Y = AL^\beta K^\alpha$, Y is total production, A is total factor productivity, L is the labour input, K is the capital input and α and β are the output elasticities of capital and labour.

To obtain total factor productivity, the formula becomes:

$$\frac{Y}{K^\alpha L^\beta} = A \quad (11)$$

Tintin (2009) put forth the argument in literature, that of total factor productivity (TFP) being a better representation of productivity. However, the impediment with TFP is the difficulty in computing and the unavailability of relevant data.

LTOT denotes Terms of Trade; LTOT presents an ambiguous impact on real exchange rate due to income and substitution effects. A rise in capital inflows permits an expansion of absorption and consequently an appreciation of the real exchange rate. LNFA denotes net foreign assets; net foreign assets are cumulative current account of net capital transfers adjusted for the effects of capital gains and losses on inward and outward FDI as well as on portfolio equity holdings (Lane and Milesi-Ferretti, 2000). LNFA has a

positive relationship in long-run equilibrium with the real exchange rate (Bleaney and Tian, 2014).

3.3.2. Real Exchange Rate Misalignment

One of the contributions of the study is to derive real exchange rate misalignment and further test the impact of misalignment on economic performance. Real exchange rate misalignment is the deviation of the real exchange rate from its desired equilibrium. Misalignment is calculated by subtracting the equilibrium real exchange rate from the actual exchange rate.

$$\text{Misalignment} = RER_t - EREER_{t-1} \quad (12)$$

Where misalignment is the real exchange rate misalignment, *RER* is the actual real exchange rate, and *ERER* is the equilibrium real exchange rate. A positive value implies that the real exchange rate is overvalued while a negative value implies that the real exchange rate is undervalued. Both occurrences have implications on the economic performance of a country.

3.3.2.1. Real Exchange Rate and Economic Performance

After obtaining the RER misalignment indicator, the impact of the misaligned RER on economic performance was assessed. Like studies by Sallenave (2010) and Vieira and MacDonald (2012), this study examined the Balassa-Samuelson and further examined real exchange rate misalignment and its implications for economic performance.

This study departs from previous studies by using difference measures of economic performance. Two models were estimated, one with GDP as an indicator of economic performance and the other indicator being unit labour costs. Unit labour costs was computed as remuneration of employees divided by total output of the Namibian economy as in Eita and Jordaan (2013). This study follows the same progression for each country. Eita and Jordaan (2013) mentioned that real exchange rate misalignment could upsurge unit labour costs thereby weakening the competitiveness of a country. Lipská, Vlnková and Macková (2005) acknowledged the unit labour cost (ULC) indicator as a paramount indicator of an economy.

The models are expressed as follows:

i) **Model 1** follows the form of Barro's Simple Model of Endogeneous Growth (1990):

Barro's original model was expressed as:

$$Y = AK^\alpha G_Y^\beta \quad (13)$$

Where Y = Real output; A = Productivity index; K = Private capital; G = Public investment.

o The model for the study is expressed as follows:

$$Y = \alpha_0 + \alpha_2 LPROD_{i,t} + \alpha_3 LPINV_{i,t} + \alpha_4 LPOP_{i,t} + \alpha_5 MISA_{i,t} + \varepsilon_{i,t} \quad (14)$$

Where LPROD is total factor productivity, LPINV is public investment proxied by government spending, LPOP denotes population growth and MISA is real exchange rate misalignment.

Increased productivity propels growth. Greater productivity enables firms to produce more output with the same input resources thus higher revenues and ultimately a higher gross domestic product. Public investment may affect growth positively or negatively. Primarily, public investment causes increased production which increases output and the employment level (Rabnawaz and Jafar, 2015). Population growth increases causes a decline in growth whilst real exchange rate misalignment impacts negatively on economic growth; an increase in misalignment leads to a reduction in economic growth.

ii) **Model 2** is expressed as:

$$LULC_{i,t} = \alpha_0 + \alpha_1 LINF_{i,t} + \alpha_2 LFDI_{i,t} + \alpha_3 LEXP_{i,t} + \alpha_4 MISA_{i,t} + \varepsilon_{i,t} \quad (15)$$

Where LULC is the unit labour cost computed by remuneration of employees divided by total output; LINF denotes inflation and LFDI denotes total investment. Higher inflation leads to a rise in unit labour costs thus there is a native relationship between inflation and unit labour costs. A negative relationship exists between foreign direct investment and unit labour costs; a fall in the unit labor costs encourages LFDI. LEXP denotes exports of goods and services. There is an inverse relationship between export developments and developments in unit labour costs. Real exchange rate misalignment negatively affects unit labour costs as well.

3.4. Data Description

The data for the period 1991 to 2016 was for five African countries which are the Democratic Republic of Congo, Mauritius, Morocco, South Africa and Tunisia obtained from Quantec. The sample period and the countries under investigation were selected on the premise of data availability.

3.4.1. Estimation Technique

The pooled mean group estimator (PMG) is employed. The PMG is consistent and efficient in the estimation of parameters' averages and long-run estimators for large sample sizes (Pesaran and Smith, 1995). Parameters are independent across groups and potential homogeneity between groups is not considered. Short-run dynamic specifications differ from country to country and long-run coefficients are controlled to be similar.

The PMG contains pertains maximum likelihood estimation of an ARDL model which can be written as an error correction model (ECM); it is a panel version of the ARDL (Saxegaard, Roudet and Tsangarides, 2007). It involves estimating an ARDL model of order (p_i,q_i):

$$\Delta y_{it} = \phi_i y_{it-1} + \beta_1 x_{it} + \sum_{j=1}^{p_i-1} \psi_{ij} \Delta y_{it-j} + \sum_{j=0}^{q_i-1} \delta_{ij} \Delta x_{it-j} + a_i + \varepsilon_{it} \quad (16)$$

where y_{it} is the dependent variable, x_{it} is a vector of explanatory variables, a_i denotes country-specific intercepts, ψ_{ij} and δ_{ij} are the country-specific coefficients of the short-term dynamics, and ε_{it} is an error term. Long-run coefficients are presumed to be the similar for all countries. If ϕ_i is significantly negative, a long-run relationship between y_{it} and x_{it} exists (Saxegaard et al, 2007).

The study conducted the Levin, Lin and Chu test (LLC Test), Im, Pearson and Shin test (IPS) and the Kao test for cointegration:

3.4.1.1. The Levin, Lin and Chu Test (LLC Test)

The LLC panel unit root test was utilised. The LLC was developed to cover the shortfall of individual unit root tests. Individual unit root tests are disadvantaged because of insufficient power against alternative hypotheses with rapid constant deviations from equilibrium (Baltagi, 2008).

The LLC tests for the following hypotheses:

H_0 : each time series contains a unit root

H_1 : each time is stationary

The lag p varies across individuals.

The procedure is performed as follows:

- a) Run the augmented Dickey-Fuller (ADF) for each cross section.
- b) Run two auxiliary regressions.
- c) Standardisation of residuals.
- d) Run the pooled OLS regression (Kunst, Nell and Zimmermann, 2011).

3.4.1.2. The Im, Pesaran and Shin Test (IPS)

The Im-Pesaran-Shin (IPS) test is more flexible than the Levin-Lin-Chu test because it permits heterogeneous coefficients. The null hypothesis of the IPS is as follows:

$$H_0 : \rho_i = 0 \forall i \tag{17}$$

And the alternative hypothesis is:

$$H_1 : \begin{cases} \rho_i < 0 \text{ for } & i = 1, 2, \dots, N_1 \\ \rho_i = 0 \text{ for } & i = N_1 + 1, \dots, N \end{cases} \tag{18}$$

$t\rho_i$ is the individual t-statistic for testing the null hypothesis $\rho_i = 0$ for all i . In this test, individual unit root tests are averaged $\bar{t} = \frac{1}{N} \sum_{i=1}^N t\rho_i$ (Kunst, Nell and Zimmermann, 2011).

3.4.1.3. The Kao Cointegration Test

According to Chaiboonsri et al (2010), the Kao test begins with a panel regression model where X and Y are presumed to be nonstationary:

$$Y_{it} = X_{it}\beta_{it} + Z_{it}\gamma_0 + \varepsilon_{it} \quad (19)$$

and

$e_{it}^\lambda = \rho_{it}^\lambda + v_{it}$ are residuals from the estimated equation.

The null hypothesis and alternative hypothesis are expressed as:

- Null, no cointegration: $H_0 : \rho = 1$
- Alternative, cointegration: $H_1 : \rho < 0$

The Kao test used DF-Type test statistics and ADF test statistics to test for cointegration.

$$DF_\rho = \frac{\sqrt{NT}(\hat{\rho} - 1) + 3\sqrt{N}}{\sqrt{5/5}}, \quad (20)$$

$$DF_t = \sqrt{\frac{5t_p}{4}} + \sqrt{\frac{15N}{8}}, \quad (21)$$

$$DF_\rho^* = \frac{\sqrt{NT}(\hat{\rho} - 1) + \frac{\sqrt[3]{N}\hat{\sigma}_v^2}{\hat{\sigma}_{0_v}^2}}{\sqrt{3 + \frac{36\hat{\sigma}_v^4}{5\hat{\sigma}_{0_v}^4}}}, \quad (22)$$

$$DF_t^* = \frac{t_\rho + \sqrt{\frac{6N\hat{\sigma}_{ov}}{2\hat{\sigma}_{ov}}}}{\sqrt{\frac{\hat{\sigma}_{ov}^2}{2\hat{\sigma}_v^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0_v}^2}}}, \quad (23)$$

$$ADF = \frac{t_{ADF} + \sqrt{6N}\hat{\sigma}_v / 2\hat{\sigma}_{\ddot{u}_i}}{\sqrt{\hat{\sigma}_{0_v}^2 / 2\hat{\sigma}_v^2 + 3\hat{\sigma}_v^2 / 10\hat{\sigma}_{0_v}^2}} \quad (24)$$

The existence of a cointegration amongst variables is followed by an estimation of the real exchange rate model. Based on its properties of providing optimal estimates of cointegrating regressions and accounting for serial correlation and endogeneity of regressors as proposed by Phillips and Hansen (1990), the fully modified least squares (FMOLS) was applied.

3.4.1.4. The Fully Modified OLS Model

Initially, the fully modified estimator was created to directly estimate cointegrating relationships by altering the traditional ordinary least squares. The traditional OLS is corrected for endogeneity and serial correlation. Previous simulation experience and empirical research has proven the good performance of FMOLS in relation to other methods estimating cointegrating relations as cited by Cappuccio and Lubian (1992) and Hageaves (1993) (Phillips, 1995).

Maddala and Kim (1998) outlined the course of the FMOLS. The FMOLS eliminates nuisance parameters by firstly modifying y_{1t} :

$$\hat{y}_{1t}^+ = y_{1t} - \hat{\omega}_{12} \hat{\Omega}_{11} \Delta y_{2t} \quad (25)$$

and the error:

$$u_{1t} \text{ by: } \hat{u}_{1t}^+ = u_{1t} - \hat{\omega}_{12} \hat{\Omega}_{11} \Delta y_{2t} \quad (26)$$

This corrects for endogeneity.

Next, we construct a serial correlation correction term δ^+ which is a consistent estimator of:

$$\delta^+ = \sum_{k=0}^{\infty} (u_{1k}^+ u_{21}^{\prime}) \quad (27)$$

$$\text{Where } u_{1t}^+ = u_{1t} - \omega_{12} \Omega_{11} \Delta y_{2t} \quad (28)$$

The FMOLS combines these two corrections to the least squares estimator

$$\tilde{\beta} = (Y_2' Y_2)^{-1} (Y_2' \hat{y}_1^+ - T \delta^+) \quad (29)$$

3.5 Estimation Results

This section presents the empirical results of the stationarity tests, the real exchange rate cointegration test, long-run coefficient, Fully Modified OLS Estimates (FMOLS) and real exchange rate misalignment and macroeconomic performance estimation.

3.5.1. Unit Root (Stationarity) Tests

The variables were subjected to the LLC and the IPS stationarity tests. The results are presented in Table 1:

Table1: Unit Root Test Results

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-0.07054 (0.4719)	-1.14415 (0.1263)	0.79557 (0.7869)	-1.07910 (0.1403)
LPROD	-1.15240 (0.1246)	-0.92410 (0.1777)	1.50259 (0.9335)	-0.05751 (0.4771)
LTOT	-0.68398 (0.2470)	-0.32210 (0.3737)	0.37277 (0.6453)	-1.37595 (0.0844)*
LNFA	0.01093 (0.5044)	0.79499 (0.7867)	1.92327 (0.9728)	3.01484 (0.9987)
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-8.16733 (0.0000)*	-6.60331 (0.0000)*	-7.04103 (0.0000)*	-5.65658 (0.0000)*
LPROD	-9.43767 (0.0000)*	-7.70112 (0.0000)*	-8.46954 (0.0000)*	-6.76304 (0.0000)*
LTOT	-8.27779 (0.0000)*	-7.25819 (0.0000)*	-8.37758 (0.0000)*	-6.92036 (0.0000)*

LNFA	-5.00458 (0.0000)*	-4.11256 (0.0000)*	-3.19374 (0.0007)*	-2.31718 (0.0102)*
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*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 1%, 5% and 10% levels of significance

Table1 depicts the LLC and the IPS panel unit root test results at levels and first difference. At levels, only LTOT is stationary at 10% level of significance. LRER, LPROD, LNFA become stationary at first difference, they are integrated of order one I(1) while LTOT is I(0). The conclusion drawn is that variables are stationary therefore the null hypothesis of the presence of a unit root is rejected.

3.5.2. Estimation of the Real Exchange Rate Cointegration Results

Table 2 presents the Kao panel cointegration test results. The decision rule of this test is rejecting the null hypothesis of no cointegration when the p value is less than 5%. The results in this study are consistent with this rule therefore; there is cointegration amongst the variables.

Table 2: Kao Cointegration Test Results

Kao Test	t-statistic	Probability
	-4.050948	0.0000*

NB: The ADF is the residual-based ADF statistic. The null hypothesis is no cointegration. * Indicates that the estimated parameters are significant at the 5% level

3.5.3. Long-run coefficient – Fully Modified OLS Estimates (FMOLS)

The results exhibit the presence of a cointegration relationship amongst the variables therefore the fully modified OLS approach was employed to estimate the long-run RER model and the results are presented in Table 3.

Table 3: FMOLS long-run - estimation results. Dependent variable: LRER

Sample Period	1991-2016
Explanatory Variables	Coefficients
LPROD	0.138157 (0.0943)*
LTOT	-0.665678 (0.0015)*
LNFA	-0.001194 (0.5424)
R-squared	0.920705
S.E. of regression	0.200896

*p-values are in parentheses ()

*10 % statistically significant.

**5 % statistically significant.

***1 % statistically significant.

Table 3 presents the long-run coefficients results of the FMOLS estimator. The results reveal that LPROD is statistically significant and consistent with economic theory. LTOT is statistically significant and consistent with economic theory. LNFA is not statistically significant and is in defiance of economic theory.

A 1% increase in LPROD will appreciate the real exchange rate by 0.1% thereby indicating a positive relationship between the two variables as stipulated by economic theory. This implies that the Balassa-Samuelson is valid and relevant to the selected African economies. In these countries, the Balassa-Samuelson theory holds. A 1% increase in LTOT will depreciate the real exchange rate by 0.7%. The relationship between terms of trade and the real exchange rate is negative and statistically significant.

3.6. Computed Real Exchange Rate Misalignment

The RER misalignment is displayed in Figure 1. Generally, there were more periods of real exchange rate undervaluation than overvaluation. Real exchange rate overvaluation is not an ideal state as it impacts negatively on economic growth negatively, therefore economic policies adopted in these countries should circumvent such occurrences.

Gylfason (2002) stated that sustained currency overvaluation deteriorates the trade balance, speculative attacks, increased foreign debt, decline in investment.

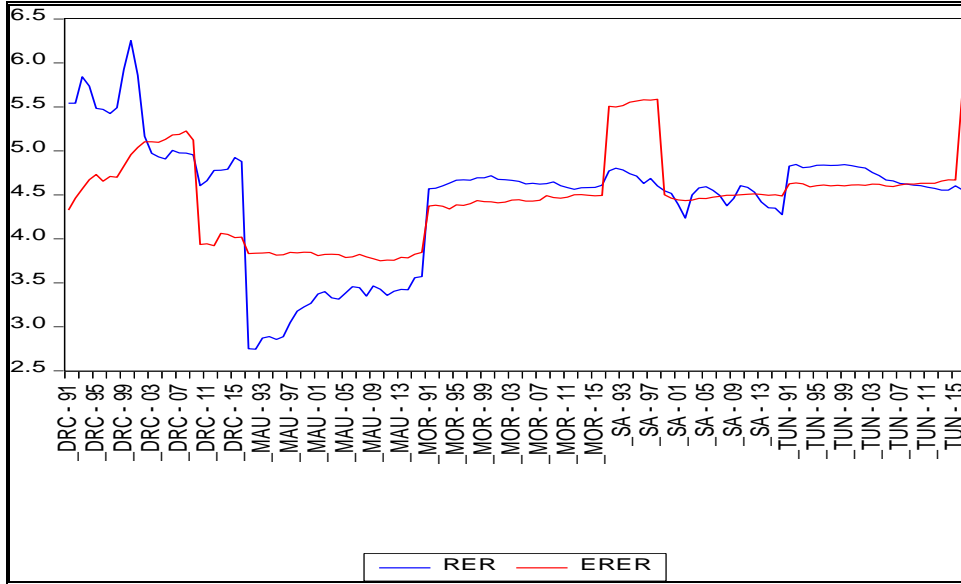


FIGURE 1: ACTUAL AND EQUILIBRIUM EXCHANGE RATE

*EKER is the equilibrium real exchange rate and RER is the actual real exchange rate

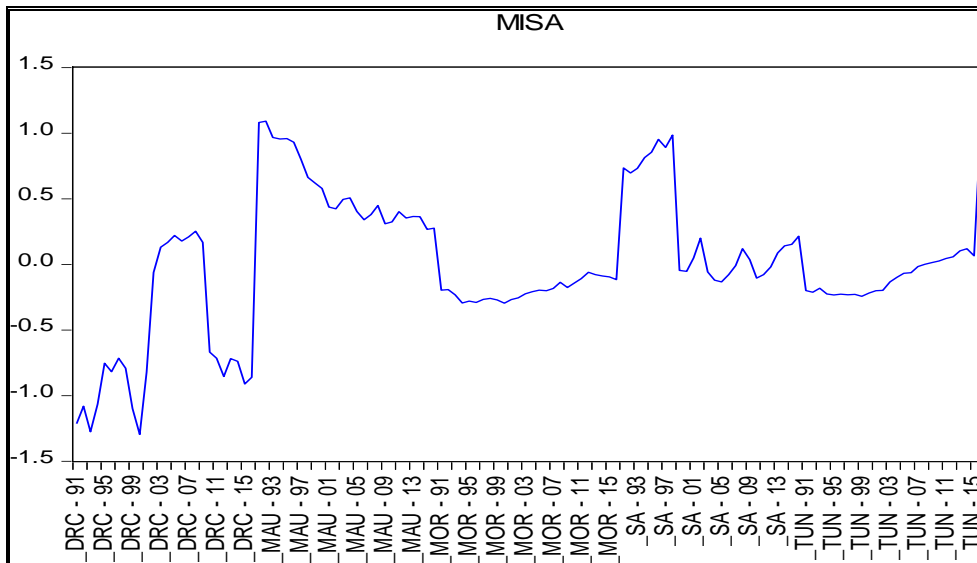


FIGURE 2: REAL EXCHANGE RATE MISALIGNMENT

*MISA denotes real exchange rate misalignment

3.7. Real Exchange Rate Misalignment and Macroeconomic Performance

3.7.1. Test for Stationarity

The results of the unit roots test are presented in Tables 4 and 5:

Table 4: Unit Root Test - Model 1

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LGDP	-3.82959 (0.0001)*	0.01853 (0.5074)	-0.34338 (0.3657)	1.91790 (0.9724)
LPROD	-1.15240 (0.1246)	-0.92410 (0.1777)	1.50259 (0.9335)	-0.05751 (0.4771)
LPINV	-1.11885 (0.1316)	-0.62953 (0.2645)	-0.02338 (0.4907)	-0.89388 (0.1857)
LPOP	-1.27066 (0.1019)	-0.46339 (0.3215)	-0.68724 (0.2460)	-1.37608 (0.0844)*
MISA	-0.24806 (0.4020)	0.46208 (0.6780)	1.72121 (0.9574)	1.22687 (0.8901)
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LGDP	-7.44804 (0.0000)*	-2.18594 (0.0144)	-9.07668 (0.0000)*	-3.37360 0.0004
LPROD	-9.43767 (0.0000)*	-7.70112 (0.0000)*	-8.46954 (0.0000)*	-6.76304 (0.0000)*
LPINV	-12.9409 (0.0000)*	-11.0543 (0.0000)*	-13.0238 (0.0000)*	-11.2803 (0.0000)*
LPOP	-2.20397 (0.0138)	0.58811 (0.7218)	-4.61573 (0.0000)*	-2.81867 (0.0024)

MISA	-5.49298 (0.0000)*	-4.24400 (0.0000)*	-6.63116 (0.0000)*	-6.34736 (0.0000)*
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*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 10%, 5% and 1% levels of significance

Table 5: Unit Root Test - Model 2

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LULC	-0.85864 0.1953	-0.05175 0.4794	-1.89422 0.0291	0.22062 0.5873
LINF	-4.78906 (0.0000)*	-4.58762 (0.0000)*	-4.51500 (0.0000)*	-4.91289 (0.0000)*
LFDI	-3.85214 0.0001	-4.71136 (0.0000)	-4.09967 0.0000	-5.71165 0.0000
LEXP	-1.05856 (0.1449)	-1.09570 (0.1366)	1.51865 (0.9356)	-1.55802 (0.0596)*
MISA	-0.24806 (0.4020)	0.46208 (0.6780)	1.72121 (0.9574)	1.22687 (0.8901)
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LULC	-7.79949 (0.0000)*	-6.64457 (0.0000)*	-8.18060 (0.0000)*	-7.11526 (0.0000)*
LINF	-14.7073 (0.0000)*	-12.9614 (0.0000)*	-14.1363 (0.0000)*	-13.2194 (0.0000)*
LFDI	-12.9409 (0.0000)*	-11.0543 (0.0000)*	-13.0238 (0.0000)*	-11.2803 (0.0000)*
LEXP	-8.98711 (0.0000)*	-8.21762 (0.0000)*	-8.11363 (0.0000)*	-7.05212 (0.0000)*

MISA	-5.49298 (0.0000)*	-4.24400 (0.0000)*	-6.63116 (0.0000)*	-6.34736 (0.0000)*
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*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 10%, 5% and 1% levels of significance

For model 1, population growth (LPOP) and LGDP are stationary at levels while public investment (LPINV), productivity (LPROD) and misalignment become stationary at first difference. For model 2 variables inflation (LINF) is I(0) while LULC, LFDI, LEXP and misalignment are I(1). These results therefore call for the rejection of the null hypothesis of a panel unit root and the acceptance of the alternative hypothesis stating that series' are stationary.

3.7.2. Real Exchange Rate Misalignment and Macroeconomic Performance Cointegration Results

The study found evidence of cointegration from Kao's panel cointegration tests, which rejected the null hypothesis of no cointegration because the p value is less than 5%, therefore there is a cointegration relationship amongst the variables.

Table 6: Kao Cointegration Test Results for Models 1 and Model 2

Model 1	t-statistic	Probability
ADF	-3.071796	0.0011*
Model 2	t-statistic	Probability
ADF	-2.445284	0.0072*

NB: The ADF is the residual-based ADF statistic. The null hypothesis is no cointegration. * Indicates that the estimated parameters are significant at the 5% level

Based on the results, the study concluded that a panel long-run equilibrium relationship among the variables exists.

3.7.3. PMG Estimation Results

This section presents the PMG estimation results for the two models using different measures of economic performance:

Table 7: PMG Results – Model 1**Dependent Variable:** LGDP

Long-run Coefficients	
LPROD	0.370866 (0.0000)*
LPINV	0.723908 (0.0000)*
LPOP	-0.129164 (0.0001)*
MISA	-0.370738 (0.0003)*
Short-run Coefficients	
ΔLPROD	-0.027976 (0.7073)
ΔLPINV	0.045155 (0.5857)
ΔLPOP	-0.155733 (0.1479)
ΔMISA	0.048788 (0.1815)
Error Correction Coefficient	-0.018867 (0.7722)

Table 8: PMG Results – Model 2**Dependent Variable:** LULC

Long-run Coefficients	
LINF	-0.063194 (0.2420)
LFDI	0.048952 (0.7481)
LEXP	-0.241559 (0.0000)*
MISA	-0.111244 (0.4856)
Short-run Coefficients	
ΔLINF	-0.022329 (0.0619)*
ΔLFDI	-0.030851 (0.1684)
ΔLEXP	0.093189 (0.6290)
ΔMISA	-0.158692 (0.1794)
Error Correction Coefficient	-0.176672 (0.2677)

Tables 7 and 8 display the PMG estimation results for both models. Model 1 employed the GDP as a measure of economic performance while model 2 employed unit labour costs. In model 2, the long-run, the relationship between LULC and real exchange rate misalignment is negative as in model 1, indicating periods of real undervaluation. However, misalignment is not statistically significant in the long-run in model 2.

3.8. Conclusion

The study investigated estimates of the Balassa-Samuelson effect on a selection of African countries given the importance of productivity for the growth of an economy. Additionally, real exchange rate misalignment was derived and its effects on economic performance were tested. Instead of using one measure of economic performance, the study used both the gross domestic product and unit labour costs.

The Balassa-Samuelson effect appeared to be valid for the selected African countries which are the Democratic Republic of Congo, Mauritius, Morocco, South Africa and Tunisia. The relationship between total factor productivity and the real exchange rate conformed to economic theory thereby confirming the validity of this theory. Both models revealed an undervalued real exchange rate in the long-run test for real exchange rate misalignment.

An undervalued real exchange rate is an ideal condition enhancing for economic growth and development in the Democratic Republic of Congo, Mauritius, Morocco, South Africa and Tunisia. Conversely, these countries need to monitor misalignment and reduce or control its impediment on economic growth and competitiveness. Furthermore, the study suggests that the Democratic Republic of Congo, Mauritius, Morocco, South Africa and Tunisia should pursue economic policies and strategies that contain real exchange rate misalignment to promote economic growth and competitiveness.

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Chapter Four

Beyond Equilibrium? An Empirical Investigation of Real Exchange Rate Overshooting in Seven African Countries

Abstract

Exchange rate overshooting explains the daily behaviour of exchange rates. Irrespective of the importance of this prodigy, not enough studies specifically in the African context exist. Hence, the study aimed to investigate the validity of the overshooting hypothesis in a panel of African countries and it was informed by the Dornbusch model of exchange rate overshooting. The random effects technique was employed to test for this relationship with variables such as money supply, real interest rates and foreign direct investment. The sample period for the study was 1985 to 2016. Moreover, the study tested for the impact of real exchange rate misalignment on economic performance. The study found evidence of exchange rate overshooting. Furthermore, real exchange rate misalignment tests revealed currency overvaluation.

Keywords: Real Exchange Rate Overshooting, Dornbusch Model of Exchange Rate Overshooting, Real Exchange Rate

4.1. Introduction

The exchange rate overshooting hypothesis is a theory that explains the behaviour of exchange rates. The overshooting hypothesis is a simplified macroeconomic framework for the study of exchange rate fluctuations. The theory was developed to monitor changes in the exchange rates, while attempting to determine the consistencies of exchange rate variations with rational expectations formation (Dornbusch, 1976).

The Dornbusch model best explained the overshooting hypothesis and exchange rate variations relating to the monetary policy (Feuerriegel, Wolff and Neumann, 2016). This model of exchange rate overshooting hypothesis has also been referred to as a “central building block in international macroeconomics” (Bjørnland, 2009). A short-run reaction (depreciation or appreciation) greater than the long-run reaction, in relation to a change in market fundamentals presents an incidence of exchange rate overshooting. Therefore, changes in market fundamentals exert an excessively great short-run effect on exchange rates. Additionally, exchange rate overshooting is vital since it clarifies why exchange rates sharply depreciate or appreciate each day (Carbaugh, 2015).

In any model where the adjustment in some markets is not instantaneous, the chances of the occurrence of exchange rate overshooting are increased. When the adjustment is gradual, exchange rate overshooting may be associated with an anticipated adjustment process when goods prices adjust gradually. When instantaneous adjustments in markets do not occur, exchange rate overshooting accompanies anticipated adjustment processes in which goods prices adjust gradually (Krueger, 1983).

There is gradual appreciation in the nominal exchange rate along the equilibrium path until a new steady state⁴ is achieved due to exchange rate overshooting. Likewise, with the real exchange rate, a shock causes it to depreciate and gradually appreciate until attaining its long-run equilibrium value (Romelli, Terra and Vasconcelos, 2015). On the

⁴A point where the diminishing returns to factor have reached its maximum such that the economy can no longer become productive in per capita terms by employing additional capital; instead a maximum limit where output per capita remains constant is reached (Nell, 2017).

other hand, the volatility of exchange rates intensifies exchange rate overshooting (Carbaugh, 2015).

The suggestion of a restrictive monetary policy in a floating exchange rate regime resulting in significant overshooting of the nominal and real exchange rate was generally acknowledged. This was due to nominal stickiness⁵(inertia) in domestic factor and product markets connected with considerably flexible nominal exchange rates (Frenkel, 1983).

Concerning the exchange rate overshooting phenomenon, many studies by Frenkel, (1982); Sichei, (2005); Chiliba, (2014); Mtenga, (2015) and Tareq and Rabbi, (2015) have been conducted; however, studies involving African countries are still scanty. Chiliba, Alagidede and Schaling (2016) resonated this by stating that research on exchange rates was largely for developed economies and developing countries, specifically, sub-Saharan countries were neglected. This study adds to the dearth of literature on the overshooting phenomenon in African countries.

Essentially, the study makes the following contributions to the body of literature. It employs the real exchange rate instead of the nominal exchange rate in testing the overshooting hypothesis. Apart from Buiter and Miller (1981) and Cavallo *et.al* (2005) most previous studies (such as Siregar and Pontines, 2005; Tareq and Rabbi, 2015) employed the nominal exchange rate and not the real exchange rate. The real exchange rate was preferred for this study because it accounts for different price adjustments. Unlike the nominal exchange rate, the real exchange rate always floats. The real exchange rate manages to move through price-level changes even in a regime of a fixed nominal exchange rate. Employing the nominal exchange rate in place of the real exchange rate is limited because the long-run effect of monetary policy on the real exchange rate is concealed. In addition to using the real exchange rate, the study uses current and high frequency data to explore exchange rate overshooting.

⁵Price stickiness or sticky prices or price rigidity refers to a situation where the price of a good does not change immediately or readily to the new market-clearing price when there are shifts in the demand and supply curve.

The study further tests for real exchange rate misalignment and the implications of real exchange rate misalignment on economic performance. This is motivated by the increased probability of experiencing intensified exchange rate overshooting and possible misalignment because of the volatility of exchange rates (Carbaugh, 2015). Real exchange rate misalignment is important because it determines the performance of an economy. The study locates itself in the Dornbusch model of exchange rate overshooting and it is motivated by the lack of empirical studies on African countries.

The study is organised as follows, section 4.2 is the literature review. Sections 4.3 and 4.4 present the methodology and the empirical models estimated. Sections 4.5 to 4.7 present and explain the empirical results, while the conclusion is presented in Section 4.8

4.2. Literature Review

This section briefly reviews the Dornbusch Model of Exchange Rate Overshooting and previous studies about exchange rate overshooting.

4.2.1. The Dornbusch Model of Exchange Rate Overshooting – An Overview

The Dornbusch model presupposes a small country in the world capital market confronted with a specified interest rate. Capital mobility warrants that expected net yields equalise such that the domestic interest rate, minus the expected rate of depreciation, equates to the world rate. The goods market assumes a supplied world price of imports.

Frenkel and Rodriguez (1982) highlighted the dependence of exchange rate overshooting on the extent of capital mobility. They estimated a modified Dornbusch model permitting restricted speed of adjustment in money markets. Findings revealed short-run effects of a monetary expansion driven by the degree of capital mobility. Thus, higher capital mobility causes the exchange rate to overshoot its long-run equilibrium value and undershoot the long-run value with immobile capital.

Domestic output is presumed an imperfect substitute of imports and aggregate demand for domestic goods which in turn affects the absolute and relative price (Dornbusch, 1976). The goods market and money market are assumed to be in equilibrium while the PPP is assumed valid only in the long-run.

Three relationships underpin the Dornbusch model:

- **Capital Mobility and Expectations**

$$r = r^* + x \quad (1)$$

Where r is the domestic interest rate, r^* is the supplied world interest rate and x is the anticipated rate of depreciation of the domestic currency. Equation (1) presents perfect capital mobility and the assumption is that all emerging capital flows guarantee that equation (1) is sustained. Equation (2) displays that the expected rate of depreciation of the spot rate is proportional to the discrepancy between the long run rate and the current spot rate (Dornbusch, 1976).

$$x = \theta(\bar{e} - e) \quad (2)$$

The coefficient of adjustment is θ and $\bar{e} - e$ are the long run and short run rate.

- **The Goods Market**

$$\ln D = u + \delta(e - p) + \gamma y - \sigma r \quad (3)$$

Where the demand for domestic output is represented by D and u is a shift parameter. The demand for domestic output relies on the relative price of domestic goods, $e - p$, interest rates and real income (Dornbusch, 1976).

- **The Money Market**

$$p - m = -\phi y + \lambda r^* + \lambda \theta(\bar{e} - e) \quad (4)$$

Equation (4) gives the relationship between the spot exchange rate, the price level, and the long run exchange rate, based on the clearing of the money market and equalisation of net market yields. m , P and y represent logs of the nominal quantity of money, the price level and real income.

The equilibrium conditions comprise clearing of the money market and reduction of the expected yields translating to a relationship between prices and the spot exchange rate. A rise in the exchange rate produces superfluous demand for domestic goods by

decreasing their relative price. Equilibrium can be restored by increasing domestic prices proportionally less because a rise in domestic prices has an impact on aggregate demand, through both the relative price effect and greater interest rates. For any given level, the exchange rate adjusts instantaneously to clear the asset market. In contrast, the goods market equilibrium is only attainable in the long run. The conditions in the goods market are essential to propelling the economy towards the long run equilibrium by inducing rising or falling prices. Achievement of the long run means equal interest rates internationally, a clearing goods market, constant prices and expected exchange rates at zero (Dornbusch, 1976).

- **Critique of the Dornbusch Model**

The model assumed instantaneous clearing of money markets and sluggish adjustment in goods markets. The model emphasised the dependence of exchange rate overshooting or undershooting on speeds of adjustment in goods and money markets. Perfect capital mobility and the complete flexibility of exchange rate formed assumptions of the Dornbusch Model. However, Frenkel and Rodriguez (1982) modified the Dornbusch model and allowed a finite speed of adjustment in money markets. The modification to the model indicated the dependence of short-run effects of a monetary expansion on the degree of capital mobility. Highly mobile capital results in the exchange rate overshooting in the long-run but immobile capital results in the exchange rate undershooting in the long-run (Tu and Feng, 2009).

Moreover, the Dornbusch Model assumed that the expenditure function was explicitly stated. However, the effects of a monetary expansion depended on the variance of expenditure function. Rogoff (2002) highlighted the failure to capture major turning points in monetary policy (Tu and Feng, 2009). Despite the highlighted shortcomings of the Dornbusch overshooting model, it remains a popular choice for practical policy analysis.

4.2.2. Empirical Literature

Buiter and Miller (1982) examined the relationship between real exchange rate overshooting and the costs of decreasing inflation. The model consisted of nominal inertia in both the level of labour costs and trend rate of growth. Findings showed that early

overshooting in the exchange rate did not reduce the output costs of steady-state inflation. Papell (1984) validated the overshooting hypothesis for the Deutsche Mark and Dollar exchange rate for Germany and the United States. Driskill (1981) estimated a reduced-form exchange-rate equation using Swiss-USA data and found evidence of short-run exchange-rate overshooting.

Frenkel and Rodriguez (1982) investigated the determinants of the evolution of exchange rates in alternative models of exchange rate dynamics context. The investigation extended to overshooting hypothesis models emphasising on differential speeds of adjustment in asset and goods markets. Frenkel and Rodriguez (1981) altered the Dornbusch model of overshooting by incorporating imperfect capital mobility as the perfect capital mobility assumption of the Dornbusch model was misleading. The study suggested that exchange rate overshooting was not an intrinsic characteristic of the foreign exchange market and it depended on certain assumptions. However, the models used in the study employed the nominal exchange rate which is limited because it does not reflect the long-run effect of monetary policy on the real exchange rate.

Engel and Flood (1985) studied an exchange rate model with sticky prices and current account-based wealth effects. The study revealed inhibited overshooting of the Dornbusch model due to the presence of wealth in the sticky price model. Bahmani-Oskooee and Kara (2000) investigated overshooting in the Turkish economy using error correction modelling and cointegration methods. Monthly data for the period January 1987 to December 1998 was utilised. Different versions of the monetary model of exchange rate determination were applied for the analysis. Results showed the Turkish lira following a path defined by monetary approach to exchange rate determination. Moreover, the lira overshoot as a reaction to quick increases in the Turkish relative money supply in both the short-run and the long-run. Bahmani-Oskooee and Kara (2000) employed the spot exchange rate which is the current rate of exchange between two currencies that has not been adjusted for prices thereby making it a nominal exchange rate.

Cavallo et al (2005) examined exchange rate overshooting and the costs of floating in all countries within the JP Morgan real effective exchange rate. The analysis was restricted

to countries with fairly liberalised capital accounts and included incidences of the currency crises of the 1990s. The investigation concluded that countries confronted by a crisis and high levels of foreign debt simultaneously were vulnerable to real exchange rate overshooting. Bahmani-Oskooee and Panthamit (2006) tested the overshooting hypothesis in Thailand, Korea, Indonesia, Malaysia and the Philippines. The study found evidence of overshooting in the short-run and found money to be neutral in the long-run. According to the neutrality of money paradigm, neutral money is insignificant in explaining the exchange rate in the long-run.

Siregar and Pontines (2005) examined exchange rate overshooting study in selected East Asian countries. Findings revealed increased frequency and severity of exchange rate overshooting of the local currency could be partially attributed to the accumulation of external debts. Tareq and Rabbi (2015) studied the movement of the exchange rates of Bangladesh and India over the period 1973 to 1998. The study found varying exchange rates in both countries over time. The exchange rate between Bangladeshi Taka and Indian rupee had overshoot severally during the period 1973 to 1998.

Although some studies have found evidence of exchange rate overshooting in Western countries, others have produced contradictory results. For instance, Eichengreen and Charles (1995) investigated impacts of shocks to U. S. monetary policy on exchange rates and found results inconsistent with the Dornbusch model. Studies such as Flood and Taylor (1996) and Kim and Roubini (2000) found contrary results to exchange rate overshooting as well.

Sichei et al (2005) employed the Dornbusch (1980) and Frankel (1979) overshooting model and the Johansen cointegration technique to estimate the nominal rand-USD exchange rate. The study showed an appropriate overshooting model and sticky commodity prices in South Africa. Chiliba (2014) employed the autoregressive distributed lag (ARDL) approach to re-examine the validity of the overshooting hypothesis for the United States Dollar/Zambian Kwacha (USD-ZMK) exchange rate. Moreover, the long-run equilibrium relationship between the USD-ZMK exchange rate and the macroeconomic fundamentals was examined. The study did not uncover any evidence of

exchange rate overshooting. Furthermore, a long-run equilibrium relationship between the exchange rate and the differentials of macroeconomic fundamentals did not exist.

Mtenga (2015) examined the behaviour of the exchange rate in a partly dollarized economy of Tanzania. The model examined the overshooting hypothesis using the Tanzanian Shilling and the United States Dollar exchange rate using the Structural Vector Autoregression (SVAR). Delayed overshooting due to a contractionary monetary policy was detected; the exchange rate appreciated for more than a year before being restored to equilibrium. The presence to overshooting was attributed to the underdevelopment of the Tanzanian foreign exchange market and imperfect information on the correct type of monetary policy shock. The delayed overshooting phenomenon is inconsistent to the Dornbusch hypothesis as the model proposed that overshooting occurs instantly after a shock and not with a delay.

4.2.2.1. Limitations of Reviewed Studies and Contribution to Literature

It is generally accepted that overshooting increases the volatility of the exchange rate which has adverse impact on trade and growth of African countries. Consequently, maintaining stable exchange rates is an important policy issue for most countries. Although much interest has been generated regarding exchange rate overshooting, there is little empirical evidence in African countries. The limited studies such as Mtenga (2015) and Chiliba (2014) have used single African countries; however, this differs by using data from a panel of African countries. Using a panel of African countries is advantageous as it will provide robust results.

Moreover, most of the reviewed studies Engel and Flood (1985), Bahmani-Oskooee and Kara (2000) and Tareq and Rabbi (2015) employed the nominal exchange rate to test for overshooting. A disadvantage of exclusively employing the nominal exchange rate is the inability to capture the long-run effect of monetary policy on the real exchange rate. The real exchange rate is a better economic indicator as it is adjusted for different price levels and reflects true economic competitiveness of a country.

Moreover, real exchange rate misalignment is derived and its effects on economic performance are tested due to the high probability of exchange rate overshooting

resulting in misalignment. Overshooting of the real exchange rate leads to real exchange misalignment as it causes a deviation of the real exchange rate from its equilibrium. Misalignment of the real exchange rate in turn influences growth. Therefore, this necessitates an investigation of exchange rate misalignment. None of the reviewed studies have derived real exchange rate misalignment.

4.3. Methodology

This section presents the model specifications, data employed, estimation techniques and analytical tools of the study.

4.3.1. Model Specification

The study adapted an empirical model from Chiliba (2014) with the variables exchange rates, money supply, real GDP, interest rates and inflation rates. However, instead of the nominal exchange rate, the real exchange rate is used like Buiter and Miller (1982). The real exchange rate is employed because it better reflects the true state of the economy as it is adjusted for different price levels. Broad money is used to denote money supply. All variables are transformed into logarithms to circumvent the assumption that variables are linearly related to the dependent variable (Chow, 1997). The model is specified as follows:

$$LRER_{i,t} = \alpha_0 + \alpha_1 LMS_{i,t} + \alpha_2 LINF_{i,t} + \alpha_3 LRIR_{i,t} + LGDP_{i,t} + \varepsilon_{i,t} \quad (5)$$

Where the real exchange rate, LRER is explained by broad money LMS, the rate of inflation LINF, real interest rates LRIR and real GDP LGDP and ε is the error term.

LMS denotes broad money which is used for the money supply variable. Broad money includes long-term bank deposits and financial assets not instantly convertible into cash (Cooke, 1996). An increased money supply leads to currency depreciation and a decrease leads to currency appreciation (Krugman and Obstfeld, 2009). LINF indicates inflation; a rise in inflation results in the depreciation of the real exchange rate while a decrease in inflation normally appreciates the real exchange rate. LRIR denotes real interest rates are adjusted for the effects of inflation, they exhibit real costs. Economic theory stipulate that higher real interest rates result in currency appreciation. LGDP

denotes the gross domestic product which has an inverse relationship with exchange rates. A real appreciation (depreciation) reduces (increases) annual real GDP growth (Habib, Mileva and Stracca, 2016).

4.3.2. Real Exchange Rate Misalignment and Economic Performance

The study derived real exchange rate misalignment which is computed by subtracting the equilibrium real exchange rate from the actual real exchange rate. Real exchange rate misalignment is the deviation of the real exchange rate from its desired equilibrium.

$$Misalignment = RER_t - EREER_{t-1} \quad (6)$$

Positive results indicate an overvaluation of the real exchange rate while negative results indicate an undervaluation of the real exchange rate

The attained RER misalignment indicator was then used to test for the impact of the misaligned RER on economic performance. This forms one of the contributions of the study. Real exchange rate misalignment affects economic performance and economic growth hence the need to investigate it.

This study estimated a model with exports as an indicator of economic performance. Exports have numerous advantages such as faster economic growth through increased rates of capital formation, improved economies of scale and faster technological change (Yaghmaian and Ghorashi, 1995). Exports are important because they drive job creation, they are also a source of business cycle creations by transferring international shocks into domestic economies (Lehmann, 2015). Through job creation and the income effect, exports increase economies of scale and encourages investment which has substantial spill-over effects on an economy (Cui, Shu and Su, 2009). The model is expressed as follows:

$$LEXP = \alpha_0 + \alpha_1 LGDP_{i,t} + \alpha_2 LIMP_{i,t} + \alpha_3 LFDI_{i,t} + \alpha_4 MISA_{i,t} + \varepsilon_{i,t} \quad (7)$$

Where LEXP is exports (annual growth), the dependent variable, LGDP denotes the gross domestic product; LIMP denotes imports (annual growth), LFDI denotes inflow of foreign direct investment and MISA is real exchange rate misalignment. Real exchange rate

misalignment may impact negatively on export performance particularly in developing nations such as Asia (Jongwanich, 2009). Several empirical studies indicate a positive relationship between a positive total exports and economic growth (Sheridan, 2012). An increase in LGDP will therefore increase exports. A bidirectional relationship between exports and LGDP exists (Bakari and Mabrouki, 2016). The relationship between exports and imports is inconclusive as some of the studies have reported unidirectional, bi-directional or no causality (Babatunde, 2014)

4.4. Data Description

The study employed annual data for the period 1985 to 2016. The choice of the period and variables employed were purely motivated by data availability. The study used a sample of seven African countries which are Algeria, Lesotho, South Africa, Uganda, Gambia, Zambia, and Sierra Leone. Data was sourced from Quantec which provides economic and financial data from sources such as the International Monetary Fund, the World Bank and Central Banks of individual countries.

4.4.1. Estimation Techniques

The random effects panel data estimation technique was employed for the annual period of 1985 to 2016.

4.4.1.1. Fixed and Random Effects Models

Most static panel data models employ the covariance estimators (pooled panel data), fixed effects and random effects estimators. Homogeneous cross-sectional units employ pooled ordinary least squares panel model while unit-specific or time-specific effects employ the fixed effects model. Fixed effects entail nonrandom quantities accounting for heterogeneity. Random subject specific effects that are not correlated with the regressors (independent variables) are called random effects models (Baltagi, 2010).

The fixed effects model and random effects model are expressed as follows:

Fixed Effects Model:

$$y_{it} = \alpha_i + \sum_{k=1}^k \beta_k x_{kit} + u_{it} \quad (8)$$

$$i = 1, \dots, N, \quad t = 1, \dots, T$$

Random Effects Model:

$$y_{it} = \sum_{k=1}^k \beta_k x_{kit} + (\alpha_i + u_{it}), \quad (9)$$

$$i = 1, \dots, N, \quad t = 1, \dots, T$$

The index i differentiates subjects and spans from 1 to N . N is the number of subjects (cross sectional unit). A subject is observed T times and the index t differentiates the observation times from 1 to T . K is the number of the explanatory variables (Baltagi, 2010).

The advantages of the fixed effects and random effects models include the production of unbiased estimates of β , however, those estimates are subject to high sample-to-sample variability for fixed effects. Random effects models permit the possible estimation shrunken residuals. Shortcomings of these models include the requirement of the estimation of per unit which reduces the model's power and increase the standard errors of the coefficient estimates (Clark and Linzer, 2015).

4.4.1.2. The Hausman Test

The Hausman test (1978) was used to decide on an appropriate model between a random effects and fixed effects model. Under the null hypothesis, H is distributed chi-square with degrees of freedom equating the number of regressors in the model. The probability value, $p < 0.05$ indicates the normal levels of significance at which the two models are different enough to reject the null hypothesis. That is, the decision to reject the random effects model in support of the fixed effects model. An insignificant difference ($p > 0.05$) is an indication that the Hausman test does not follow that the random effects estimator.

It is free from bias and is preferred over the fixed effects estimator (Clark and Linzer, 2015).

4.4.1.3. Panel Unit Root Tests

Panel unit root tests are used to test for stationarity in a panel series with the ADF regression for panel data as the baseline framework (Mućk, 2017):

$$\Delta y_{it} = \gamma_i y_{it-1} + \sum_{j=1}^p \alpha_j \Delta y_{it-j} + \varepsilon_{it}, \quad (10)$$

Where $\gamma_i = \rho_i - 1$

The null hypothesis is stipulated as:

$H_0 : \gamma_i = 0$ or $\rho_i = 1$ while the alternative hypothesis is stipulated as:

$H_1 : \gamma = \gamma < 0$ or $\rho_i = \rho < 1$ (all panels)

$H_1 : \gamma = \gamma < 0$ or $\rho < 1$ (some panels)

The Levin, Lin and Chu (LLC) test, Im, Pesaran and Shin (IPS test) and the Fisher type test were used in this study. The LLC test assumes homogeneity in a series, the IPS is more flexible than the LLC test and the Fisher-type test joins p-values of individual statistics (Mućk, 2017).

4.5. Estimation Results

This section presents and discusses the stationarity test results, the Hausman test results, the random effects model, the real exchange rate misalignment and macroeconomic performance estimation.

4.5.1. Stationarity Tests

The stationarity results of the LLC, IPS and ADF Fisher tests are presented in Table 1:

Table1: Unit Root Test Results

Method	LRER	LMS	LRIR	LGDP	LINF
LLC: Individual intercept	-5.04465 (0.0000)*	-1.57274 (0.0579)	-4.52552 (0.0000)*	-7.91123 (0.0000)*	-4.27504 (0.0000)*
Individual Intercept and Trend	-3.33967 (0.0004)*	-2.87003 (0.0021)*	-4.47245 (0.0000)*	-8.87388 (0.0000)*	-6.72690 (0.0000)*
IPS: Individual intercept	-3.79146 (0.0001)*	-1.47875 (0.0696)	-5.37802 (0.0000)*	-7.92957 (0.0000)*	-4.31199 (0.0000)*
Individual Intercept and Trend	-2.85266 (0.0022)*	-2.61331 (0.0045)*	-5.18951 (0.0000)*	-10.2182 (0.0000)*	-5.87397 (0.0000)*
ADF Fisher: Individual intercept	53.5352 (0.0000)*	23.3625 (0.0546)	61.1945 (0.0000)*	89.7434 (0.0000)*	49.3973 (0.0000)*
Individual Intercept and Trend	30.5170 (0.0065)*	35.1803 (0.0014)*	61.0652 (0.0000)*	104.015 (0.0000)*	65.6381 (0.0000)*

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Lag selection criteria: Automatic selection of maximum lags

Values in parenthesis are the probability values relating to the test statistic.

The tested variables are integrated of the same order. They are $I(0)$ at levels of the panel unit root tests, meaning that they are all stationary. Thus, the null hypothesis is rejected in favour of the alternative hypothesis. To affirm and obtain robust results, the LLC test, the IPS and ADF Fisher unit root tests were applied. All tests showed the same results. Tests for cointegration are not performed because the variables are of order zero, implying that they do not share a common trend therefore they cannot be cointegrated.

4.5.2. Hausman Test

The next step entailed choosing the appropriate panel data estimation method. The Hausman's (1978) test was employed to examine random versus fixed effects models (Baltagi, 2005).

○ **Test Hypothesis:**

Null Hypothesis: Random effects model is appropriate

Alternative Hypothesis: Fixed effects model is appropriate

Table 2: Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f	Prob.
Cross-section random	3.761340	4	0.4393

Given the results of the Hausman test, the random effects model was employed. Table 3 displays the estimated long-run relationship.

Table 3: Random Effects Model

Dependent Variable: LRER

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.765568	0.285327	20.20689	0.0000
LRIR	-0.015108	0.003666	-4.120735	0.0001***
LMS	-0.261138	0.071540	-3.650228	0.0003**
LINF	-0.003248	0.001746	-1.860264	0.0642*
LGDP	-0.003239	0.022644	-0.143046	0.8864
*10 % statistically significant. **5 % statistically significant. ***1 % statistically significant.				

The random effects model shows the relationship between the dependent variable LRER and its explanatory variables. The relationship between the real exchange rate and money supply is negative in accordance with economic theory. In the overshooting model, an increase in the money supply can cause the exchange rate to overshoot its long-run level in the short-run. The results suggest exchange rate overshooting in the selected countries as the relationship between the real exchange rate and money supply is statistically significant. The relationship between the real exchange rate and inflation is inverse and statistically significant. A 1% rise in inflation results in the depreciation of the real exchange rate by 0.003%. Although statistically significant, the relationship between real exchange rates and real interest rates is in defiance of economic theory. Economic

theory stipulates that higher real interest rates should lead to currency appreciation. The gross domestic product has a negative relationship with real exchange rates as stated by economic theory; however, it is statistically insignificant in the stipulated model.

4.6. Computed Real Exchange Rate Misalignment

The RER misalignment is displayed in Figure 1. Generally, there were periods of undervaluation and overvaluation observed. Real exchange rate overvaluation is not an ideal state as it impacts negatively on economic growth negatively; therefore, economic policies adopted in these countries should circumvent such occurrences. Additionally, real exchange rate misalignment negatively impacts on exports (Diallo, 2011).

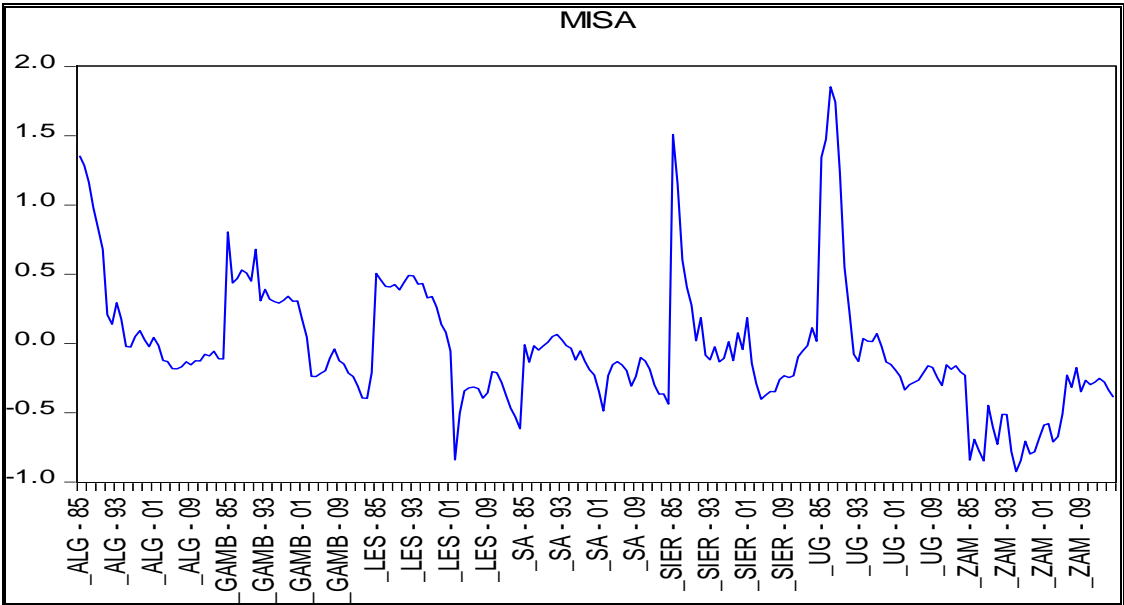


Figure 1: REAL EXCHANGE RATE MISALIGNMENT

*Misa denotes real exchange rate misalignment

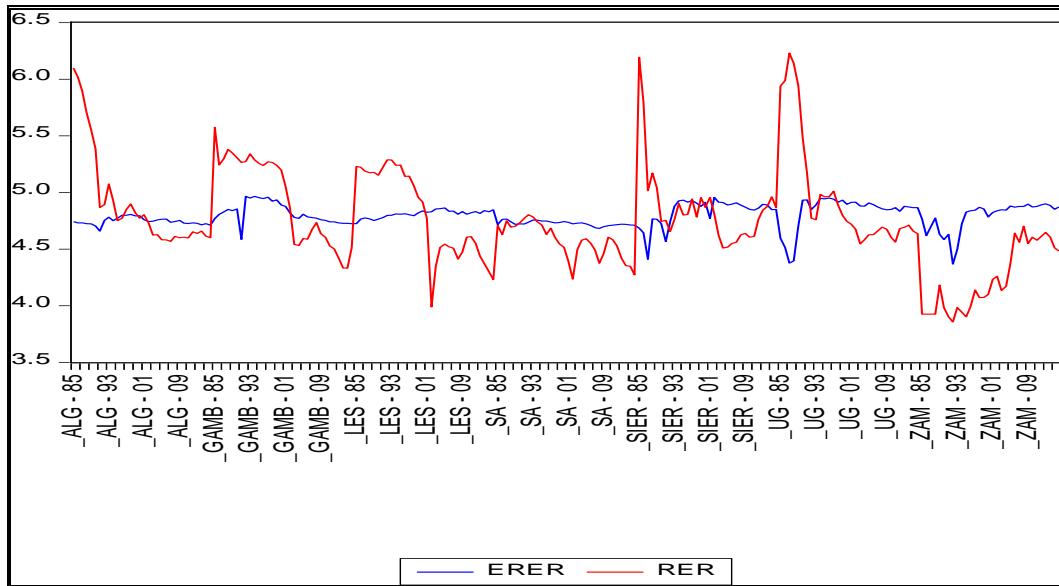


Figure 2: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATE

*ERER is the equilibrium real exchange rate and RER is the actual real exchange rate

4.7 Real Exchange Rate Misalignment and Macroeconomic Performance

4.7.1 Test for Stationarity

The results of the unit roots test conducted on the models specified in section 4.3.2. are presented in Table 4:

Table 4: Stationarity Test Results

Method	LEXP	LIMP	LFDI	LGDP	MISA
LLC: Individual intercept	-11.5648 (0.0000)*	-9.45976 (0.0000)*	-3.52465 (0.0002)*	-7.91123 (0.0000)*	-5.41866 (0.0000)*
Individual Intercept and Trend	-10.3435 (0.0000)*	-8.94471 (0.0000)*	-2.99495 (0.0014)*	-8.87388 (0.0000)*	-3.14739 (0.0008)*
IPS: Individual intercept	-10.8630 0.0000	-9.74424 (0.0000)*	-4.22167 (0.0000)*	-7.92957 (0.0000)*	-3.31068 (0.0005)*
Individual Intercept and Trend	-10.4246 (0.0000)*	-8.42310 (0.0000)*	-3.72826 (0.0001)*	-10.2182 (0.0000)*	-2.62245 (0.0044)*
ADF Fisher: Individual intercept	120.051 (0.0000)*	105.696 (0.0000)*	44.5592 (0.0000)*	89.7434 (0.0000)*	42.7865 (0.0001)*

Individual Intercept and Trend	104.915 (0.0000)*	84.4118 (0.0000)*	47.5865 (0.0000)*	104.015 (0.0000)*	27.8272 (0.0150)*
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*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Lag selection criteria: Automatic selection of maximum lags

Values in parenthesis are the probability values relating to the test statistic.

The applied unit root tests revealed that variables are stationary at levels, including real exchange rate misalignment variable. They are of order zero $I(0)$ at levels of the panel unit root tests, meaning that they are all stationary. Thus, the null hypothesis of non-stationarity is rejected in favour of the alternative hypothesis stating that variables are stationary.

4.7.2. Hausman Test

The Hausman (1978) test was employed to select the appropriate model to apply between the random effects model and fixed effects model.

- **Test Hypothesis:**

Null Hypothesis: Random effects model is appropriate

Alternative Hypothesis: Fixed effects model is appropriate

Table 5: Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f	Prob.
Cross-section random	6.828652	4	0.1452

The Hausman test revealed that the random effects model was appropriate as the probability value exceeds 5%. Table 7 displays the estimated long-run relationship.

Table 6: Random Effects Model

Dependent Variable: LEXP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.153229	0.217720	-0.703789	0.4823
LGDP	0.424062	0.124627	3.402657	0.0008***
LFDI	0.138807	0.158225	0.877281	0.3813
LIMP	0.424036	0.061655	6.877591	0.0000***
MISA	0.311716	0.294944	1.056865	0.2917

*10 % statistically significant.
**5 % statistically significant.
***1 % statistically significant.

The random effects model presents the relationship between the dependent variable LEXP and the explanatory variables (LGDP, LFDI, LIMP, MISA). The relationship between LEXP and LGDP is positive in accordance with economic theory. A 1% rise in LGDP will increase LEXP by 0.42%. The relationship between LEXP and LIMP is statistically significant. A 1% increase in LIMP will result in higher exports by 0.42%. The relationship between LEXP and LFDI and LEXP and Misalignment is not statistically significant. Economic theory stipulates that real exchange rate misalignment impacts negatively on export performance particularly in developing countries.

4.8. Conclusion

The study empirically investigated the validity of the overshooting hypothesis in Algeria, Lesotho, South Africa, Uganda, Gambia, Zambia, and Sierra Leone. This study was motivated by the lack of studies on the overshooting phenomenon in African countries and it is informed by the Dornbusch model of exchange rate overshooting. Furthermore, the study tested for real exchange rate misalignment and the effects of misalignment on economic performance. The data set span from 1985 to 2016. The study used the Pooled OLS Regression Model to pool all observations and estimates extensive regression. After applying the Hausman test, the Random Effects Model was selected for analysis.

The relationship between the real exchange rate and money supply conformed to economic theory thus suggesting exchange rate overshooting in the selected African countries. In the overshooting model, an increase in the money supply can result in the exchange rate overshooting its long-run level in the short-run. The relationship between the real exchange rate and money supply was statistically significant. Real exchange rate misalignment was also derived and tested on economic performance. Export growth was used as an indicator of economic performance. The results showed a positive and statistically insignificant real exchange rate misalignment coefficient. However, the implication is that the real exchange rate is overvalued. Economic theory stipulates that real exchange rate misalignment impacts negatively on export performance particularly in developing countries.

Based on the results of the study, suggestions are that the selected countries pursue and adopt economic policies that circumvent the overvaluation of the real exchanges rate. For instance, this can be achieved by monitoring real exchange rate misalignment. Reducing or controlling real exchange rate misalignment promotes economic growth and competitiveness thereby improving the general economic landscape of these countries.

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Chapter Five

The Relationship between Real Exchange Rates and Commodity Prices in a Selection of African Countries

Abstract

This study investigated the relationship between real exchange rates and commodity prices in Algeria, South Africa, Tunisia, Uganda, Zambia, Morocco, Cote d'ivoire and the Central African Republic for the period of 1995 to 2015. Different models for different commodity sectors were estimated to test this relationship including the energy sector which has become pertinent for most developing economies. Moreover, the study derived real exchange rate misalignment because most economies of developing countries are dependent on commodity exports and are more susceptible to experiencing misaligned exchange rates. Findings of the study revealed a statistically insignificant long-run relationship between real exchange rates and commodity prices. Real exchange rate misalignment results demonstrated significant periods of undervaluation for the different models.

Keywords: Real Exchange Rate, Commodity Prices, Misalignment

5.1. Introduction

The African continent is richly endowed with a third of the world's mineral assets and a tenth of global oil reserves. The commodities on the continent are diverse, they include cotton, coffee, diamonds, oil, gold, uranium, phosphates and iron ore (Deaton, 1999). Commodities are normally classified into different sectors such as energy, industrial metals, precious metals and agricultural products. Energy commodities include crude oils and its refinements, industrial metals include copper or iron, precious metals include gold or silver and agricultural commodities includes all food-related products (Ielpo, 2018).

Generally, African economies are reliant on international commodity prices thus appending their domestic economic activities to commodity price variations (Osigwe, 2015). Commodity prices do not remain below their production cost for protracted periods. Correspondingly, commodity markets do not remain above production costs for protracted periods due to higher prices promoting increased production, resulting to downward price pressure (Ielpo, 2018). Thus, developing countries dependent upon the production of primary commodities are susceptible to commodity price shocks which have significant economic outcomes. These outcomes may be either positive or negative (Bodart, Candelon and Carpantier, 2015).

In developing countries such as African countries, commodity prices may result in macroeconomic instability. The reliance of these economies on natural resources increases the probability of economic instability (Osigwe, 2015). Increment of commodity prices inhibits growth prospects and exerts pressure on inflation to increase. This is due to fluctuations that may transpire in prices of commodities in international markets (Osigwe, 2015). Commodity price fluctuations present difficulties and opportunities for economists and policymakers (Ito and Rose, 2011). Commodity prices possess unique characteristics; they are volatile, normally denominated in one currency and show full and prompt pass-through of exchange rates (Ito and Rose, 2011).

Literature on the "Dutch disease" has revealed that economic performance of a country is possibly affected by commodity price shocks through the real exchange rate. The "Dutch disease" refers to anticipated modifications in the production structure due to

favourable shocks. Such shocks include, the discovery of significant natural resources or an increment in the international price of an exportable commodity understood to be permanent (Brahmbhatt, Canuto, and Vostroknutova, 2010). In turn, the result is the reliance of real exchange rates on commodity prices (or terms of trade). Several empirical studies have found linkages between increases in the world price of commodity prices and an appreciation of the real exchange rate (Bodart, Candelon and Carpentier, 2015).

This highlights the importance of the equilibrium position of the real exchange rate as it affects the efficient allocation of resources between the tradable and non-tradable sectors. Misalignment of the real exchange rate (deviation from the point of equilibrium) leads to macroeconomic imbalances and sends incorrect signals to economic agents thereby hampering the efficient allocation of resources (Tashu, 2015). Considering these facts, this study sought to investigate the relationship between the real exchange rate and commodity prices in African countries, most of which primarily depend on commodity exports. There are several studies by Edwards (1986); Dupont and Juan-Ramon (1996); Cashin *et.al* (2004); MacDonald and Ricci (2004) and more recently, Ayres, Hevia and Nicolini (2017) who have investigated this relationship.

Most recently, studies such as Nyathi (2017) are focused on the influence of energy currencies on real exchange rates. Cashin *et.al* (2004) and other scholars in literature distinguished between oil and other energy commodities. Thus, the contribution of the study is twofold; the study investigates the impact of energy currencies on the real exchange rate in commodity exporting African countries. Evidence in literature suggests that the performances of open economies, like South Africa, are vulnerable to exchange rate volatility due to rapid fluctuations in energy prices as found by Nyathi (2017). Based on this evidence, it is imperative to conduct this study; however, this analysis extends to other African countries and is not a single country study. Secondly, this study derives real exchange rate misalignment in a panel of selected African countries. Misalignment of the real exchange rate causes macroeconomic imbalances and sends incorrect signals to economic agents affecting the efficient allocation of resources as highlighted by Tashu (2015).

The chapter is presented as follows, section 5.2 is the literature review, Sections 5.3, 5.4 and 5.5 present the research methodology and data description, Section 5.6 presents the results and lastly, section 5.10 presents the conclusion.

5.2. Literature Review

Edwards (1986) tested interactions among commodity export prices, money creation, inflation, and the real exchange rate with the focus on influences of changes in coffee prices on the real exchange rate in Colombia. The study revealed a close relation of coffee prices to money creation and inflation. The study also revealed a partially contained real appreciation emanating from the increase in coffee prices due to money creation and adjustments in the nominal exchange. A shortcoming of Edward's model was the assumption of the exogeneity of the fiscal deficit, which was incongruous for Colombia (Edwards, 1986). Perez-Reyna and Osorio-Rodriguez (2016) resonated Edwards (1986) by mentioning that the fall of the price of increased fiscal losses in coffee exports due to movements in the exchange rate.

Dupont and Juan-Ramon (1996) studied the variations in real exchange rates in major currencies and real commodity prices. The study created a supply and demand multi-country model incorporating speculative and non-speculative demands. Monthly data from January 1972 to January 1992 for sixty-five commodity prices was employed. The study revealed a dollar-denominated price affected by the deutsche mark and the yen for a small group of commodities.

Chen and Rogoff (2002) examined the determinants of real exchange rate movements for three OECD economies (Australia, Canada, and New Zealand) where primary commodity production is essential for development. However, a setback in this study was the presence of a purchasing power parity puzzle in the residual even after controlling for commodity price shocks. The purchasing power parity puzzle provided evidence for contradictory statements regarding the PPP (Rogoff, 1996). The study found a valid relationship between exchange rates and commodity prices for Australia and New Zealand while for Canada, the relationship appeared to be mixed and qualitative. For

Canada, the results suggested a long-run cointegrating relationship with relatively weak co-movements in the shorter run.

Ferraro, Rogoff and Rossi (2015) interrogated the presence of a short-term relationship between changes in the price of a country's major commodity export and changes in the nominal exchange rate. The study identified a robust relationship using a nominal Canadian dollar exchange rate with the motivation that real and nominal Canadian dollar exchange rates are closely related. Therefore, the repercussions of using nominal exchange rate instead of the real exchange rate could be negligible. However, utilising real exchange rates is advantageous for more accurate findings as the real exchange rate entails adjustments for different price levels.

Kohlscheen *et.al* (2016) employed a systematic method to investigate the relationship between commodity prices and exchange rates of key commodity exporters. The analysis was based on a timely proxy for terms of trade and market price information of eighty-three associated proxy commodities. The study found that commodity prices forecasted exchange rate movements of commodity exporters up to two months ahead when based on in-sample panel regressions.

Ayres, Hevia and Nicolini (2017) argued that variations in commodity prices were influential on volatility in real exchange rates among developed economies including the United States, Japan, Germany and the United Kingdom. They employed a model that considered commodities to obtain a relationship between real exchange rates and productivity shocks and commodity prices. The study showed that a small number of commodity prices explained a considerable amount of the movements in real exchange rates (RER) in these countries.

Cashin *et.al* (2004) examined the movement of real exchange rates of commodity exporting countries and the real prices of their commodity exports. They employed Deaton and Miller's (1996) study and constructed indices of real commodity prices for each commodity-dependent economy. The period for the study was 1980 to 2002 for fifty-eight commodity-exporting countries including African countries such as Zimbabwe, Tanzania, Zambia, Togo and Mozambique. The study found evidence of a long-run

relationship between national real exchange rate and real commodity prices for approximately one-third of the commodity-exporting countries.

In their estimation of the equilibrium real exchange rate for South Africa, MacDonald and Ricci (2004) employed commodity prices as an independent variable in the investigation of a long-run cointegrating association between the real exchange rate and other factors. Economic theory stipulates that a rise in the world price of the commodities exported by a country normally appreciates the real exchange rate. The study constructed six different indicators of commodity prices based on three choices of the aggregate chief commodities exported by South Africa and two ways of deflating them. The study found that variations in commodity prices greatly influenced movements in the real exchange rate. However, the model violated a condition necessary for an equilibrium exchange rate model, that of endogeneity. The exchange rate being endogenous in the model such that disequilibria must have a feedback effect on the real exchange rate (Du Plessis, 2005).

Bodart *et.al* (2015) employed structural factors to test for the potential existence of a relationship between real exchange rates and commodity prices in developing countries. These countries specialise in exportation of a main primary commodity and they include Nigeria, Sudan, Tanzania, Mali, Malawi and Kenya. The commodities were grouped in three categories: energy, metals and agriculture. The study found that structural factors were important determinants of the long-run commodity price elasticity of the real exchange rate and they were also found to be statistically robust.

Arezki *et.al* (2012) explored the relationship between the South African Rand and gold price volatility using the Vector Error Correction Model (VECM) for the period 1980-2010. The study exhibited a unilateral long-run relationship between the real effective exchange rate volatility and gold price volatility. These results showed gold price volatility as an important element in explaining the excessive exchange rate volatility of the South African Rand. Choudhri and Schembri (2014) explored the behaviour of the Canada–US real exchange rate based on the influence of sectoral productivities and commodity prices. Findings of the study showed a significant long-run effect between sectoral productivities and commodity prices.

Babatunde (2015) explored the differential effects between the oil price and exchange rate in Nigeria using a time series and structural analysis approach. The study revealed differing responses of the exchange rate to positive and negative oil price shocks. Positive oil price shocks led to a depreciation of the exchange rate, while negative oil price shocks appreciated the exchange rate. Moreover, statistical evidence did not support asymmetric effects of positive and negative oil price shocks on the real exchange rate.

Dauvin (2014) explored the link between energy prices and the real effective exchange rate for ten energy-exporting and twenty-three commodity-exporting countries for the period 1980 to 2011. A panel cointegrating approach was applied to assess the relationship between the real exchange rate and its fundamentals. The study further showed that low oil price variations implied real effective exchange rates undetermined by terms-of-trade but by other usual fundamentals. In highly volatile oil markets, currencies follow an "oil currency" regime and terms-of-trade becomes a driver of the real exchange rate.

Nyathi (2017) examined the relationship between energy prices and the real effective exchange rate in South Africa using annual data for the period 1970 to 2014. A long-run co-integration relationship between the real effective exchange rate and its fundamentals was estimated with the Balassa Samuelson effect considered. Findings of the study resonated with existing literature, that is, a long-run equilibrium relationship between the real effective exchange rate and its fundamentals was found. Tsen (2011) found that energy prices and oil prices as reflected in terms of trade explained the real exchange rate in Malaysia.

Rautava (2004) investigated the effect of international oil prices on real exchange rate in the Russian economy and fiscal policy. The study applied the VAR methodology and cointegration techniques for the period 1995: Q1 to 2001: Q3. Findings of the study showed an association between a 10% perpetual rise (decline) in global oil prices in the long-run and a 2.2% growth (fall) in the level of Russian GDP. Correspondingly, a 10% real appreciation (depreciation) of the Russian rouble correlated to a 2.4% decline (increase) in the level of output. Results of the study also confirmed the presence of reliance of fiscal revenues on output and oil price fluctuations.

5.2.1. Limitations of Reviewed Studies and Contribution to Literature

Similar to the reviewed studies by Cashin *et.al* (2004); MacDonald and Ricci (2004); Ayres, Hevia and Nicolini (2017); Rautava (2002); Choudhri and Schembri (2014), this study sought to establish the relationship between the real exchange rate and commodity prices and the implications of fluctuations of these prices on the real exchange rate. Given the dependence susceptibility of the performance of open economies on exchange rate volatility due to rapid fluctuations in energy prices; the study also investigated the role of energy prices in influencing the exchange rate. Limited studies such as Nyathi (2017) have conducted single country studies but this analysis extends to other African countries.

The study further derived real exchange rate misalignment which the other studies have not done, to the best knowledge of the researcher. The study is motivated by the lack of studies that investigate the effects of real exchange rate misalignment in developing countries. Yet, developing countries are most vulnerable to real exchange rate misalignment (Montiel and Hinkle (1999) and Abida (2010)). Countries with exports dominated by primary commodities are more susceptible to high real exchange rate misalignment in comparison to those with a limited number of primary commodities in their exports.

5.3. Methodology

This section presents the analytical techniques employed in the study. The equilibrium real exchange rate is estimated, and real exchange rate misalignment is derived.

5.3.1. Model Specification

Following a review of theoretical and empirical literature, the study adopted the following models. Like Ieplo (2018) the study focused on certain commodities given the spectrum of existing commodities. Three models each representing a different sector of commodities were estimated, namely, agriculture, manufacturing and energy. Agricultural commodity prices are represented by agricultural raw exports; energy commodity prices are proxied by fuel exports and manufacturing commodity prices by manufacturer exports. The variables utilised in the study were motivated by economic theory and literature reviewed from previous studies. The models are specified as follows:

$$LRER_{i,t} = \alpha_0 + \beta_1 LFUEL_{i,t} + \beta_2 LINFL_{i,t} + \beta_3 GDPCAP_{i,t} + \beta_4 LNFAS + \varepsilon_{i,t} \quad (1)$$

$$LRER_{i,t} = \alpha_0 + \beta_1 LAGRIC_{i,t} + \beta_2 LFDI_{i,t} + \beta_3 LGDPCAP_{i,t} + \beta_4 LNFAS_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$LRER_{i,t} = \alpha_0 + \beta_1 LMAN_{i,t} + \beta_2 LTOT_{i,t} + \beta_3 LGOVEXP_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where LRER is the real exchange rate. The study used the real effective exchange rate (REER) to represent the real exchange rate. REER is the weighted average of a country's currency in relation to an index or basket of other major currencies. An increase in LRER signals an appreciation while a decrease signals depreciation.

Commodities comprise of agricultural products, fuels, and metals normally traded in bulk on a commodity exchange market. These are represented by LFUEL, LAGRIC and LMAN. Commodity prices are prices associated with the purchase of these commodities. An increase in commodity prices leads to wage increases and an appreciation of the real exchange rate. LINFL denotes inflation. A rise in inflation results in the depreciation of the real exchange rate while a decrease in inflation normally appreciates the real exchange rate. LGDPCAP denotes GDP per Capita. An increase in GDP per capita results in the appreciation of the real exchange rate through the Balassa-Samuelson effect, that is, a rise in the relative price of non-traded goods emanating from higher productivity gains in the traded goods sector (Fanizza, 2002). LNFA denotes net foreign assets. An appreciation in net foreign assets leads to an appreciation of the real exchange rate (Ricci, Lee and Milesi-Ferretti, 2008).

LTOT denotes Terms of trade. LTOT has two possible effects on the real exchange rate; the income and substitution effects. An increase in export prices or a decline in import prices which in turn increases the income in an economy and the demand for non-tradables is known as the income effect. The income effect reduces the relative prices of tradables to non-tradables and appreciates the Real Exchange Rate (RER). On the other hand, the substitution effect improves the TOT because of increased export prices which result in a depreciation of RER for certain levels of nominal exchange rate and non-tradable prices.

LGOVEXP denotes Government Expenditure. Government expenditure is the aggregate amount that a country spends on goods and services. The influence of government spending on the real exchange rate is dependent upon the composition of public spending, the underlying financing policy, the intensity of private capital in production, and the relative productivity of public infrastructure (Chatterjee and Mursagulov, 2012). In the short-run, the real exchange rate is expected to appreciate as government spending increases; growth in government consumption leads to a rise in the demand for non-traded goods and the simultaneous appreciation of the real exchange rate. There have been studies, however, that have found evidence of government spending resulting in a real depreciation of the exchange rate in the short- run (Chatterjee and Mursagulov, 2012). LFDI denotes Foreign Direct Investment. The impact of foreign direct investment on real exchange rate is dependent on how the foreign investment is employed, whether for the purchase of tradable goods or non-tradable goods. If the investment is used in the acquisition of tradables, the domestic currency depreciates. If the investment is used in the acquisition of non-tradable goods, the real exchange rate appreciates. Therefore, the sign of the coefficient on foreign investment cannot be predetermined (Zakaria and Ghauri, 2011).

5.3.2. Data Description

The time span for the study was from 1995 to 2015. Eight African countries were included in the study and they are Algeria, South Africa, Tunisia, Uganda, Zambia, Morocco, Cote d'ivoire and the Central African Republic. Data for the study was obtained from the Quantec database which provides an array of organised and updated economic data. Quantec consolidates data from the International Monetary Fund, the World Bank and Central Banks of individual countries. The variables were transformed into logarithms. Advantages of transforming variables into logarithms include, rescaling data for a constant variance, moving a positively skewed distribution closer to normal distribution and turning a non-linear multiplicative relationship between variables into a linear and additive one (Brooks,2008).

5.3.3. Estimation Technique

A panel estimation technique was used to examine the relationship between the real exchange rate and commodity prices because of its advantages over cross-sectional and time series data for a large data set. It controls for heterogeneity among individual countries, minimises collinearity, permits more degrees of freedom and data to be collected for individual countries over time. Hence, any elimination biasness that could result from aggregation is accounted for. For the approximation of a long-run relationship between panel data, the Dynamic Ordinary Least Squares (DOLS) method was applied.

5.3.3.1. Panel Unit Root Tests

The data was first subjected to the unit root test to test for the stationarity of the data. There are numerous panel unit root techniques available for such an assessment. The study employed the Levin, Lin and Chu Test (LLC Test) and the Im, Pesaran and Shin test.

- **Levin, Lin and Chu Test (LLC Test)**

The Levin-Lin-Chu Test for unit root (LLC) proposed the following hypotheses:

H₀: each time series contains a unit root

H₁: each time series is stationary

The lag order p varies across individuals.

The LLC test is run as follows:

Step 1: The augmented Dickey-Fuller (ADF) regression is run per cross-section:

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{L=1}^p \theta_{iL} \Delta y_{i,t-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad m=1,2,3 \quad (4)$$

Step 2: Two auxiliary regressions are run:

- a. Δy_{it} on $\Delta y_{i,t-L}$ and d_{mt} to get residuals $\hat{\varepsilon}_{it}$ and
- b. $y_{i,t-1}$ on $\Delta y_{i,t-L}$ and d_{mt} to get residuals $\hat{v}_{i,t-1}$

Step 3: In the third step residuals are standardised and finally the pooled OLS regression is run:

$$\tilde{e}_{it} = \rho \bar{v}_{i,t-1} + \tilde{\varepsilon}_{it} \quad (5)$$

Where $\rho = 0$ is the null hypothesis (Baltagi, 2008).

- **Im, Pearson and Shin Test (IPS)**

The Im, Pearson and Shin Test (IPS) is more flexible than the LLC test because it permits heterogeneity among coefficients of y_{it-1} . The null hypothesis is that all series have unit roots:

$$H_0 : \rho_i = 0 \forall_i$$

The alternative hypothesis permits some of the individual series to have unit roots

$$H_1 : \begin{cases} \rho_i < 0 & \text{for } i = 1, 2, \dots, N_1 \\ \rho_i = 0 & \text{for } i = N_1 + 1, \dots, N \end{cases}$$

Where t_{pi} is the individual t-statistic for testing the null hypothesis. The test is then based on averaging individual unit root test $\bar{t} = \frac{1}{N} \sum_{i=1}^N t_{pi}$ (Baltagi, 2008).

5.4. Test for Cointegration

Following the stationarity tests, the Kao test for cointegration was performed to determine the existence of a long-run equilibrium relationship among the variables.

5.4.1. Kao Cointegration Test (1999)

The study employed the Kao test for cointegration which uses two tests. The first test is a Dickey-Fuller type test and the second test is an Augmented Dickey-Fuller type test. The null hypothesis under test is that of no cointegration for panel data while the alternative is that of cointegration for panel data (Kao, 1999).

5.5. Fully Modified OLS and Dynamic OLS

The Fully Modified OLS (FMOLS) and Dynamic OLS are applied to approximate the existence of a long-run association between panel data. Phillips and Hansen (1990) created the FMOLS to give optimum estimates of cointegration regressions. The technique is a further modification of least squares to accommodate the influences of serial correlation and the endogeneity in the regressors that result from the presence of a cointegrating relationship. The FMOLS applies to models with I(1) and I(0) regressors as well as models with deterministic trends (Phillips, 1995). The FMOLS is a two-step procedure; firstly, the equation $y_t = \beta x_t + z_t$ is estimated and secondly, semi-parametric corrections are made for the serial correlation of the residuals z_t and for the endogeneity of the x regressors (Buch and Prieto, 2014). On the one hand, the dynamic OLS proposed by Stock and Watson (1993) includes leads and lags of differenced explanatory variables to static cointegration regressions as means of eliminating small sample bias that result from correlation between the error term and the explanatory variables. This study employs the DOLS method.

5.6. Real Exchange Rate Misalignment

The study explored the short and long-run determinants of the real exchange rate and then computed the RER misalignment by subtracting the equilibrium real exchange rate from the actual exchange rate.

$$\text{Misalignment} = RER_t - EREER_{t-1} \quad (6)$$

Where misalignment is the real exchange rate misalignment, RER is the actual real exchange rate, and $ERER$ is the equilibrium real exchange rate. Positive results indicate real exchange rate overvaluation while negative results indicate real exchange rate undervaluation.

Like Palić, Dumičić and Šprajčak (2014), the study calculated the equilibrium real exchange rate through the cointegration approach. The real exchange rate and its fundamentals are included in the cointegration analysis. The Hodrick- Prescott filter is

then applied to obtain permanent values of the equilibrium real exchange rate. Lastly, real exchange rate misalignment is calculated as the deviation of the real exchange rate from its permanent equilibrium level.

5.7. Estimation Results

This section presents the outcome of the empirical tests and discusses the findings.

5.7.1. Stationarity Tests

The variables were subjected to the LLC and the IPS stationarity tests. The results are presented in Tables 1, 2 and 3.

Table1: Unit Root Test - Model 1

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-1.89993 (0.0287)*	-0.92436 (0.1776)	-0.68488 (0.2467)	-1.35937 (0.0870)
LFUEL	-4.27730 (0.0000)*	-3.47937 (0.0003)*	-4.16797 (0.0000)*	-2.39229 (0.0084)*
LINFL	-4.76309 (0.0000)*	-0.42776 (0.3344)	1.65483 (0.9510)	2.48483 (0.9935)
LGDP CAP	-5.04728 (0.0000)*	2.62703 (0.9957)	-0.32786 (0.3715)	1.24690 (0.8938)
LN FAS	-32.2122 (0.0000)*	86.9489 (1.0000)	-28.2143 (0.0000)*	1.62403 (0.9478)
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-6.17440 (0.0000)*	-5.46879 (0.0000)*	-5.73345 (0.0000)*	-5.07805 (0.0000)*

LFUEL	-20.0685 (0.0000)*	-16.7294 (0.0000)*	-22.0215 (0.0000)*	-19.1432 (0.0000)*
LINFL	-7.53178 (0.0000)*	-7.27887 (0.0000)*	-7.59956 (0.0000)*	-7.58945 (0.0000)*
LGDP CAP	-2.80080 (0.0025)*	-0.07386 (0.4706)	-3.77332 (0.0001)*	-1.44993 (0.0735)
LNFAS	-115.753 (0.0000)*	139.539 (1.0000)	-42.8321 (0.0000)*	-9.17165 (0.0000)*

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Table 2: Unit Root Test - Model 2

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-1.89993 (0.0287)*	-0.92436 (0.1776)	-0.68488 (0.2467)	-1.35937 (0.0870)
LAGRIC	-2.77973 (0.0027)*	-3.03013 (0.0012)*	-2.49323 (0.0063)*	-1.99545 (0.0230)*
LFDI	-1.96872 (0.0245)*	0.32200 (0.6263)	-2.46079 (0.0069)*	-1.14785 (0.1255)
LGDP CAP	-5.04728 (0.0000)*	2.62703 (0.9957)	-0.32786 (0.3715)	1.24690 (0.8938)
LNFAS	-32.2122 (0.0000)*	86.9489 (1.0000)	-28.2143 (0.0000)*	1.62403 (0.9478)
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-6.17440 (0.0000)*	-5.46879 (0.0000)*	-5.73345 (0.0000)*	-5.07805 (0.0000)*
LAGRIC	-9.80376 (0.0000)*	-7.82819 (0.0000)*	-9.86616 (0.0000)*	-7.28640 (0.0000)*

LFDI	-9.67548 (0.0000)*	-8.98834 (0.0000)*	-10.6800 (0.0000)*	-11.1729 (0.0000)*
LGDP	-2.80080 (0.0025)*	-0.07386 (0.4706)	-3.77332 (0.0001)*	-1.44993 (0.0735)
LNFAS	-115.753 (0.0000)*	139.539 (1.0000)	-42.8321 (0.0000)*	-9.17165 (0.0000)*

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Table 3: Unit Root Test - Model 3

Variable	LLC Test		IPS Test	
	Levels		Levels	
	Constant	Constant and Trend	Constant	Constant and Trend
LRER	-1.89993 (0.0287)*	-0.92436 (0.1776)	-0.68488 (0.2467)	-1.35937 (0.0870)
LMAN	-1.76060 (0.0392)*	-3.28694 (0.0005)*	-1.80807 (0.0353)*	-2.50967 (0.0060)*
LTOT	-2.71978 (0.0033)*	-2.20289 (0.0138)*	-0.05330 (0.4787)	-2.09002 (0.0183)*
LGOVEXP	0.32718 (0.6282)	-5.80594 (0.0000)*	-1.10839 (0.1338)	-3.29404 (0.0005)*
Variable	First Difference		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
	LRER	-6.17440 (0.0000)*	-5.46879 (0.0000)*	-5.73345 (0.0000)*
LMAN	-8.67544 (0.0000)*	-8.91958 (0.0000)*	-8.66474 (0.0000)*	-8.28509 (0.0000)*
LTOT	-6.51363 (0.0000)*	-7.00561 (0.0000)*	-6.33625 (0.0000)*	-6.02669 (0.0000)*
LGOVEXP	-8.54071 (0.0000)*	-6.35898 (0.0000)	-8.80352 (0.0000)*	-5.40318 (0.0000)

*p-values are in parentheses ()

* indicates rejection of the null hypothesis of unit root at 5% level of significance

Tables 1, 2 and 3 depict the results of the LLC and the IPS panel unit root tests at levels and first difference. At first difference, most series are I(1) at both the constant trend of the panel unit root test. These results therefore, call for the rejection of the null hypothesis stating that series are non-stationary. Tests for stationarity allowing for a constant plus trend yield the same results hence the rejection of the null hypothesis. The IPS unit root test was also conducted to affirm the LLC unit root test results. The IPS test yielded the

same results; therefore, the null hypothesis of non-stationarity is rejected. The conclusion is that most of the variables are stationary at constant and trend as shown by the LLC and IPS test.

5.8. Cointegration Results

Table 4 reports the results of Kao's residual panel cointegration tests, which rejected the null hypothesis of no cointegration because the p value is less than 5%, therefore there is a cointegration relationship amongst the variables.

Table 4: Kao Cointegration Test Results for Model 1, Model 2 and Model 3

Model 1	t-statistic	Probability
ADF	-2.785885	0.0027***
Model 2	t-statistic	Probability
ADF	-1.848372	0.0323***
Model 3	t-statistic	Probability
	-1.391458	0.0820**

NB: The ADF is the residual-based ADF statistic. The null hypothesis is no cointegration. * Indicates that the estimated parameters are significant at the ***5% level, **10% level and *1% level

The cointegration results lead to the conclusion that there is a panel long-run equilibrium relationship among the real exchange rate and the independent variables at significance level 5% for model 1 and 2, while model 3 exhibits a cointegrating relationship at 10% level of significance.

5.8.1. Long-run coefficient - Dynamic OLS Estimates (DOLS)

The results indicate that a cointegration relationship exists amongst the variables therefore, the dynamic OLS approach is employed to estimate the long-run RER model and the results are presented in Table 5.

Table 5: DOLS long-run - estimation results. Dependent variable: LRER

Sample Period	1995-2015	1995-2015	1995-2015
Explanatory Variables	Model 1 Coefficients	Model 2 coefficients	Model 3 coefficients
LFUEL	-0.022845 (0.7479)		
LINFL	0.083620 (0.6106)		
LGDPCAP	-0.313827 (0.0413)**	-0.048481 (0.7611)	
LNFAS	0.002915 (0.0346)**	0.003354 (0.0546)*	
LAGRIC	-	-0.069411 (0.3857)	
LFDI	-	-0.081698 (0.4385)	
LMAN			0.033765 (0.3479)
LOT			0.533722 (0.0000)**
LGOVEXP			0.047120 (0.5838)

R-squared	0.923535	0.874158	0.951549
S.E. of regression	0.085864	0.110152	0.056331

*p-values are in parentheses ()

*10 % statistically significant.

**5 % statistically significant.

***1 % statistically significant.

Table 5 presents the long-run coefficients results of the DOLS estimator. The results reveal that LGDPCAP is statistically significant in model 1, however, the coefficient is not consistent with economic theory. LNFAS in models 1 and 2 is statistically significant and consistent with economic theory. LTOT in model 3 is statistically significant.

A 1% increase in net foreign assets (LNFAS) will appreciate the real exchange rate by 0.003% in model 1 and by 0.0033% in model 2, thus demonstrating a positive relationship between the two variables as specified by economic theory. A 1% increase in terms of trade (LTOT) will appreciate the real exchange rate by 0.53%, the relationship between terms of trade and the real exchange rate is positive and statistically significant. Each of the models depict R^2 greater than 80%. This implies that the models are generally a good fit as more than 80% of the variations of the dependent variable is explained by the independent variables. In the long-run, the relationship between energy commodity prices denoted by fuel exports, agricultural commodity prices denoted by agricultural raw exports and manufacturing commodity prices denoted by manufacturer exports and the real exchange rate is not statistically significant.

5.9. Computed Real Exchange Rate Misalignment

After the estimation of the long-run relationship between the RER and the selected macroeconomic fundamentals (inflation, GDP per capita, terms of trade, government expenditure, foreign direct investment and net foreign assets) the HP filter was employed to obtain the permanent values of fundamentals. Thereafter, RER misalignment was derived. RER misalignment is the deviation of the RER from its permanent equilibrium level.

Figures 1 and 2 depict RER misalignment for model 1, which is further summarised in Table 6.

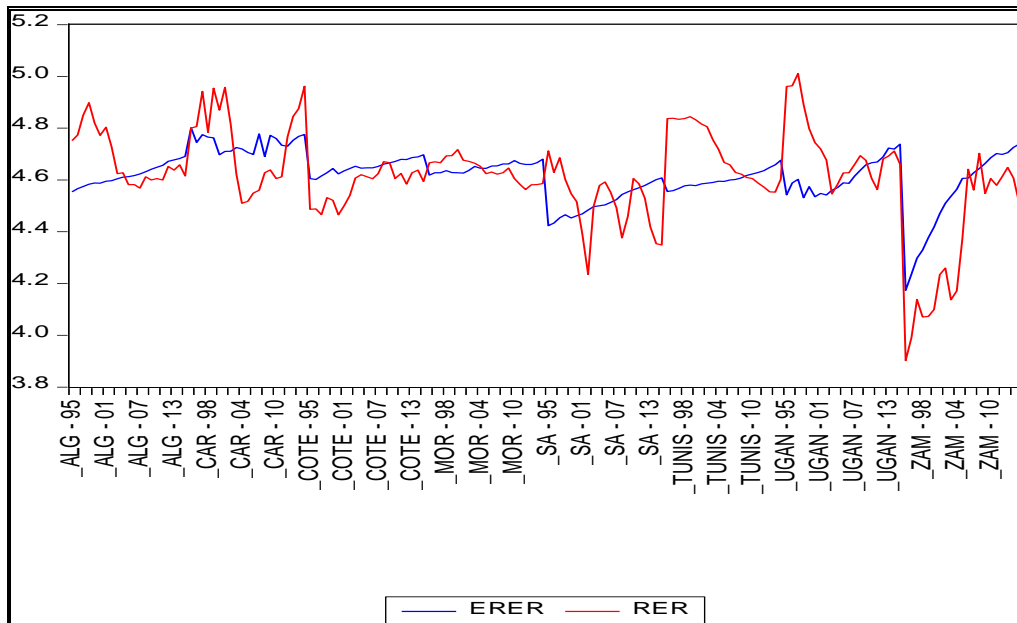


Figure 1: Actual (RER) and Equilibrium (ERER) Real Exchange Rate

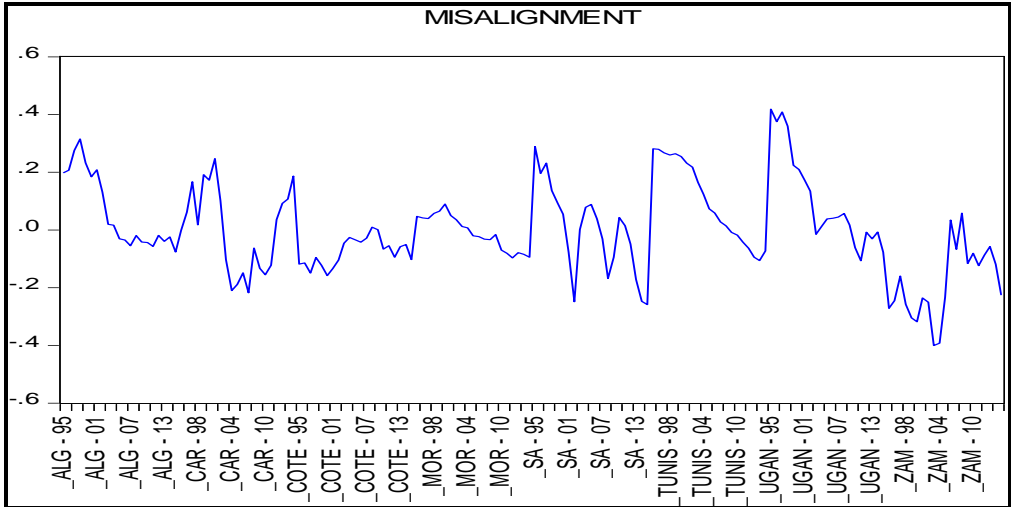


Figure 2: Real Exchange Rate Misalignment

Figures 3 and 4 depict RER misalignment for model 2, which is further summarised in Table 6.

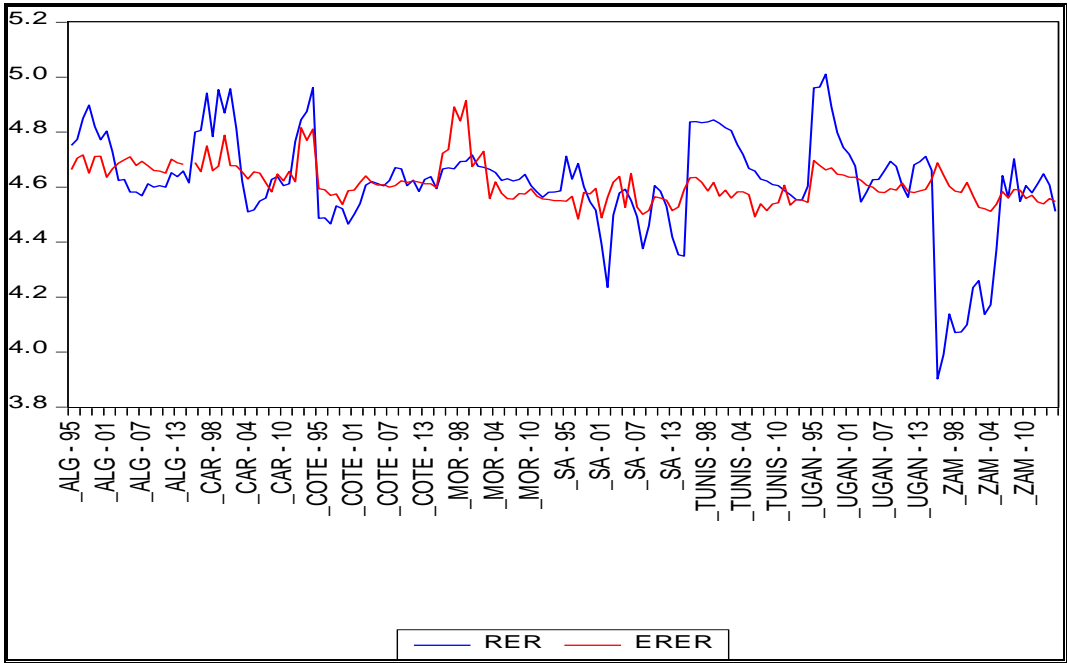


Figure 3: Actual (RER) and Equilibrium Real Exchange Rate (ERER)

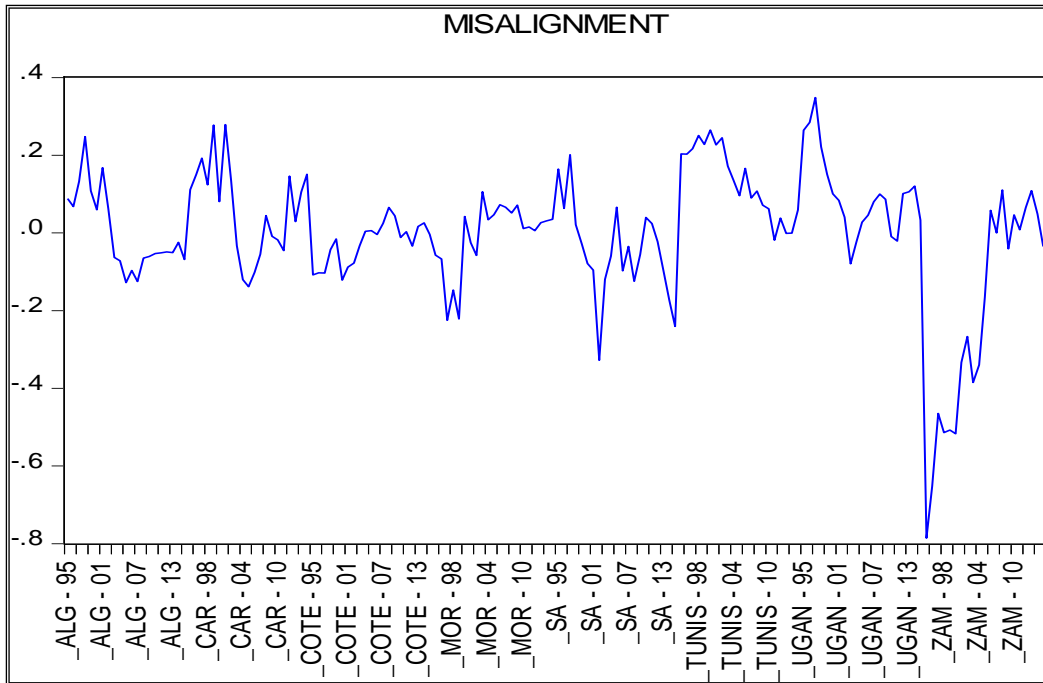


Figure 4: Real Exchange Rate Misalignment

Figures 5 and 6 depict RER misalignment for model 3, which is further summarised in Table 6.

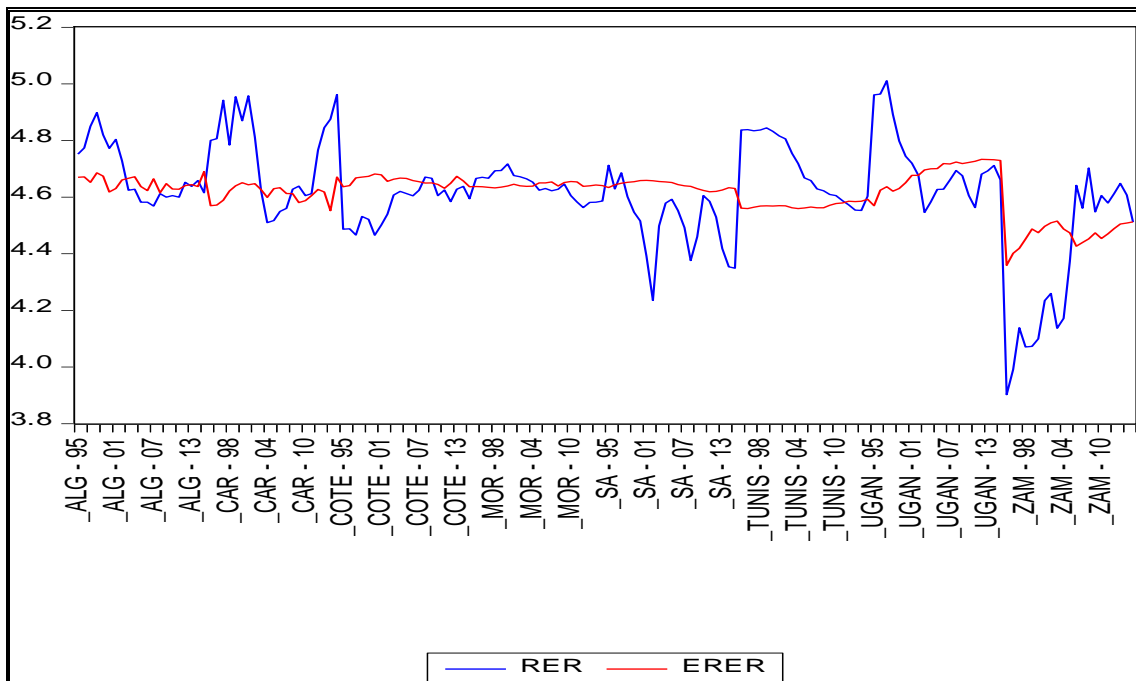


Figure 5: Actual (RER) and Equilibrium Exchange Rate (ERER)

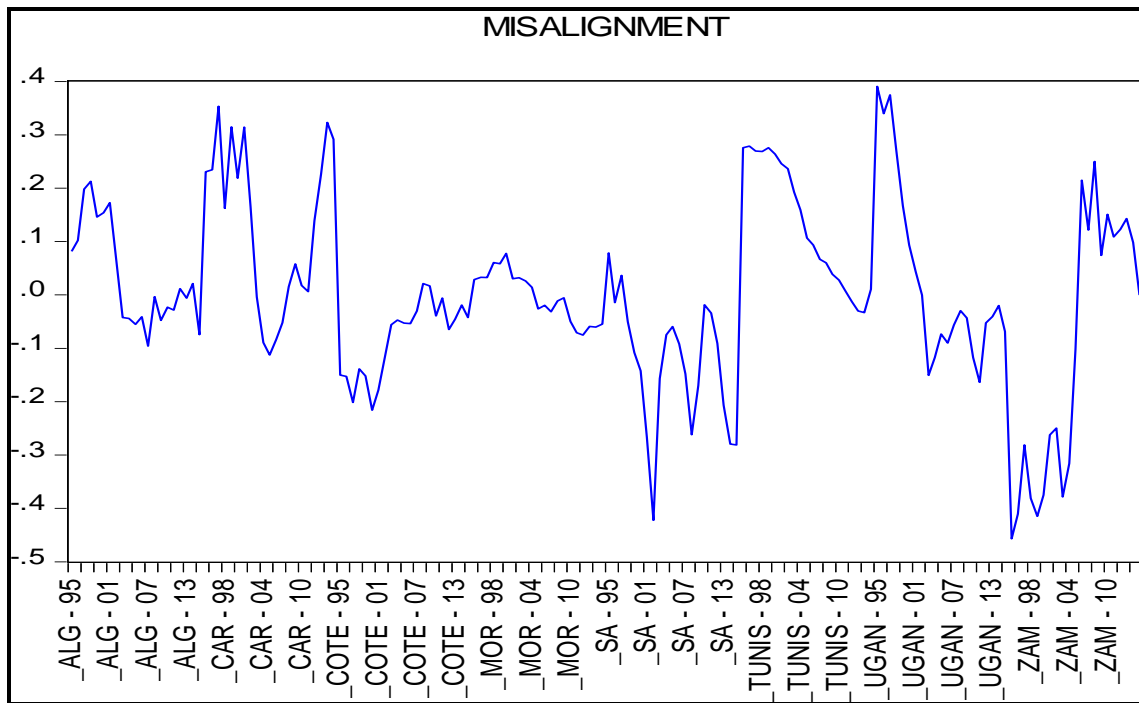


Figure 6: Real Exchange Rate Misalignment

Edwards (1986) stated that an exchange rate (ER) is regarded as undervalued when its depreciation exceeds the equilibrium real exchange rate (ERER) and it is regarded as overvalued when its appreciation exceeds the equilibrium real exchange rate (ERER). Generally, all three models depict more periods of undervaluation than overvaluation. Overvaluation refers to positive RER misalignment while undervaluation refers to negative RER misalignment. Table 6 presents a summary of incidences of RER misalignment in the three models of the selected African countries.

Table 6: Incidences of Real Exchange Rate Misalignment

MODEL	PERIOD	OUTCOME
MODEL 1	1995-2015	Undervaluation
MODEL 2	1995-2015	Undervaluation
MODEL 3	1995-2015	Undervaluation

The results showed dominant periods of undervalued exchange rates. An undervalued exchange rate influences growth positively through increased capital stock in the economy. An undervalued real exchange rate also encourages private investment in the

traded goods sector (Conrad and Jagessar, 2018). Though an undervaluation influences growth positively, it may also lead to some inflationary pressures and the constraining of necessary resources for domestic investment which may restrict growth of supply-side potential (Williamson, 1990). Nunnenkamp and Schweickert (1990) and Haddad and Pancaro (2010) resonated Williamson (1990) by highlighting that an undervaluation could result in inflation and overheating of an economy. In light of the facts above, the study purports that developing countries such as African countries avoid periods of excessive undervaluation in order to propel growth in their economies.

5.10. Conclusion

This study investigated the relationship between the real exchange rate and commodity prices in eight African countries. The African countries studied were determined by availability of data. African countries are richly endowed with natural resources hence a majority rely on international commodity prices. This in turn appends their domestic economic activities to the variations of commodity prices. Due to their variability, commodity prices may result in macroeconomic instability in developing countries thus increasing incidences of economic instability in African countries.

The study also acknowledged the increasing popularity of the relationship between real exchange rates and energy currencies. Some studies in literature suggested that the performance of open economies were susceptible to exchange rate volatility due to rapid fluctuations in energy prices. Three models were estimated by the study, each representing a different sector of primary commodities including the energy sector. Furthermore, real exchange rate misalignment was attained because such countries with exports dominated by primary commodities have a higher probability of experiencing real exchange rate misalignment. Real exchange rate misalignment is calculated as the deviation of the observed real exchange rate from its desired equilibrium level. Misalignment results demonstrated significant periods of undervaluation for the three models which are suitable for economic growth. That is why countries such as China have adopted the undervaluation strategy. However, with excessive undervaluation follows trivial growth therefore currencies must be close to their equilibrium levels. Literature also suggests that periods of undervaluation should be kept in moderation to control for inflationary pressures.

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Chapter Six

Conclusion and Policy Recommendations

6.1. Introduction

Appropriate and effective exchange rate policies are instrumental in setting African economies on a path of sustainable economic growth and development. In light of this fact, this study sought to explore issues of exchange rates in African economies. The study consisted of four separate but intertwined articles in the field of exchange rates, meaning that, the real exchange rate was the fundamental subject of this study.

6.2. Summary of the Findings

The first article investigated the relationship between the real exchange rate and macroeconomic fundamentals for a selected panel of African countries. Two models were estimated for time periods 1995 to 2016 and 1990 to 2016. This study made a contribution by using the most recent data to estimate the equilibrium real exchange rate and further tested the effects of real exchange rate misalignment on economic performance. Previous studies had not derived real exchange rate misalignment which impacts on the economic performance of a country (see Miyajima, (2007); Ozsoz and Akinkunmi, (2012); Mkenda, (2005). Limited studies such as Eita and Sichei (2014), Ndlela (2012) and Mkenda (2001) derived real exchange rate misalignment and further tested the resultant impact on economic performance but the studies were single countries that cannot be generalised to Africa. The results of this study revealed significant relationships between the real exchange rate and some macroeconomic fundamentals. Furthermore, negative and positive coefficients for real exchange rate misalignment for the different models and samples were found, showing periods of undervaluation and overvaluation of the real exchange rate. Recommendations emanating from this study were that developing countries such as African countries should adopt economic policies that encourage competitive real exchange rates and also eschew sustained real exchange rate appreciation as this restrains economic growth.

The second article investigated the validity of the Balassa-Samuelson Effect from a selection of five African countries. The study estimated the equilibrium real exchange with total factor productivity as an explanatory variable and further derived real exchange rate misalignment and tested its effects on economic performance. The study departed from other studies by using more than one measure of economic performance in assessing the effects of real exchange rate misalignment on economic performance. Employing multiple measures of economic performance was advantageous because it improved the robustness of the results and offered consilience and real or reliable through triangulation (Kuorikoski, Lehtinen and Marchionni, 2007). The results revealed a valid Balassa-Samuelson effect in the selected countries and negative coefficients for real exchange rate misalignment. Recommendations emanating from this study were that countries should adopt economic policies and strategies that control real exchange rate misalignment to stimulate economic growth and competitiveness.

The third article explored exchange rate overshooting in the African context, particularly because a few exist. The study was underpinned by the Dornbusch model of exchange rate overshooting. The study contributed to the body of literature by employing the real exchange rate instead of the nominal exchange rate in testing the overshooting hypothesis. Most previous studies (see Siregar and Pontines, 2005; Tareq and Rabbi, 2015) employed the nominal exchange rate which does account for different price adjustments. Additionally, the study tested for the impact of real exchange rate misalignment on economic performance. The sample period for the study was 1985 to 2016 and the findings showed evidence of exchange rate overshooting. Moreover, an insignificant relationship between the real exchange rate misalignment and economic performance as denoted by exports was revealed. The study recommended that economic policies adopted in developing countries such as African countries should avoid the overvaluation of the real exchange rates as this affects economic growth and development negatively.

Lastly, the fourth article examined the relationship between real exchange rates and commodity prices in eight African countries for the period of 1995 to 2015. Different models for different commodity sectors were estimated to test this relationship. The

energy sector which has become pertinent for most developing economies was also included in the analysis. Moreover, the study derived real exchange rate misalignment because most economies of developing countries are dependent on commodity exports and are more susceptible to experiencing misaligned exchange rates. The study provided evidence of a statistically insignificant long-run relationship between real exchange rates and commodity prices. Real exchange rate misalignment results further demonstrated significant periods of undervaluation for the three models which are favourable for economic growth. Based on the results, this study advocated for the adoption of the undervaluation strategy which provides a stimulating environment for economic growth and development.

6.3. Recommendations

This study made some policy recommendations that would encourage African economies to adopt appropriate and effective exchange rate policies that promote sustainable economic growth and development.

For African economies to advance and develop, they must avoid excessive periods of real exchange rate misalignment. Real exchange rate misalignment is calculated as the deviation of the observed real exchange rate from its desired equilibrium level. Misalignment needs to be monitored as it can hamper economic growth and competitiveness. Hinkle and Montiel (1999) suggested that countries should avoid sustained real exchange rate appreciation whereby the actual real exchange rate (RER) differs significantly from its long-run equilibrium value. The real exchange rate must be close to its desired equilibrium as best possible.

Real exchange rate misalignment, particularly, resulting in an overvalued currency hinders economic growth and development. In as much as an overvaluation promotes efficiency in domestic industries and puts a downward pressure on inflation, the costs of reduced inflation far outweigh the benefits. An overvalued currency reduces the competitiveness of a country in the international market as imported goods become cheaper. This causes damage to domestic industries and the general domestic economy as consumers are inclined to importing goods because of cheaper costs. Jongwanich

(2009) highlighted other consequences of sustained real exchange rate overvaluation such as vulnerability to speculative attacks and currency crises due to unstable macroeconomic environments. Such instances hinder African economies in terms of potential and sustainable economic growth and development. Economic policies that promote competitive real exchange rates must therefore be adopted. In addition, a temporary ban or increased tariffs on the imported goods, especially if they are not commodities to be used in the production of other goods locally.

An undervalued real exchange rate is preferred for encouraging sustainable economic growth. Hence, countries such as China have adopted the undervaluation strategy where their currency is deliberately depreciated to improve internal growth. Most developing countries influence the real exchange rate through policy instruments such as fiscal consolidation and capital controls to attain competitive real exchange rates, and subsequently, real undervaluation. Benefits of the undervaluation strategy include better competitive exports in the global market, reduced trade deficits due to exports becoming cheaper and imports becoming expensive. Empirical evidence from various scholars such as Rodrik (2009) and Servén (2010) indicate that real exchange rate fluctuations influence growth. Rodrik (2009) contended that real undervaluation encouraged economic growth, raised profitability of the tradable sector, and expanded the share of tradables in domestic value added. Servén (2010) showed increased growth in the tradables sector as a result of real exchange rate undervaluation.

The selected African economies may adopt such strategies as currency undervaluation to boost economic growth and development. However, with excessive undervaluation follows trivial growth therefore currencies must be close to their equilibrium levels. An undervaluation may result in imported inflation if the raw materials used in production are expensive as they affect the general prices of products produced.